

Project Manual

Bid Set Submittal

MOORPARK LIBRARY

5301 California Avenue, Suite 100
Irvine, California 92617

Volume 1 of 2:
Divisions 01 to 12

LPA
Project No. 30647
March 13, 2025



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DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 10 00 – SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Description of construction delivered under a single contract.

1.2 PROJECT INFORMATION

- A. Project Name: MOORPARK CITY LIBRARY
- B. Project Address: 83 High Street
- C. Owner: City of Moorpark
- D. Architect of Record: LPA, INC
5301 California Ave, Suite 100
Irvine, Ca 92617
949-261-1001

1.3 PROJECT DESCRIPTION

- A. The City of Moorpark Library is proposed as a new 17,500 sf single story building fronting on High Street, Moorpark, Ca, 93021. The scope of the new building includes structural, mechanical, electrical, plumbing, and low voltage systems. The project also includes a new parking lot, pedestrian access, site grading, and site drainage.

1.4 CONTRACTOR'S USE OF THE PREMISES

- A. The work includes providing supervision, labor, materials, and equipment for such construction.
- B. During the construction period the Contractor shall have limited access to the premises for construction operations. Contractor's use of premises is limited to the areas indicated on the Drawings.
- C. Owner will not occupy premises during construction: Perform construction only during normal working hours, which will be restricted based upon construction activity, unless otherwise agreed to in advance by Owner. Clean up work areas and return to a useable condition at the end of each work period.

1.5 SPECIFICATION FORMAT AND CONVENTIONS

A. Format:

1. Specifications are organized into Divisions and Sections using the 49-division format and the Construction Specifications Institute's (CSI) "MasterFormat" numbering system.
2. Sections in Division 01 govern the execution of the Work of subsequent specification sections.

B. Titling and arrangements: The order of articles, paragraphs, subparagraphs, and sub-subparagraphs in the Specifications text is defined by a sequence of indentations.

1. Article, paragraph and subparagraph titles, and other identifications of subject matter in the Specifications, are intended as aid in locating and recognizing various requirements in the beginning words of a sentence.
2. Where the title establishes the subject, the titles are subordinate to and do not define, limit, or otherwise restrict the Specification text.
3. Specification text shall govern over titling and shall be understood to be and interpreted as a whole.

C. Interpretation:

1. The captions and headings of the various subdivisions of the Contract Documents are intended only as a matter of reference and convenience and in no way define, limit, or prescribe the scope or intent of the Contract Documents or any subdivision thereof.
2. Underlining, bolding or capitalizing of words in the text does not signify or mean that such words convey special or unusual meaning.

D. Content: Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

1. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred, as the sense requires.
2. Use of the singular number shall be deemed to include the plural and vice versa, whenever the context requires.
3. The neuter gender shall include the feminine and masculine, the masculine gender shall include the feminine and neuter, the singular number shall include the plural, and the plural shall include the singular, whenever the context requires.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 13 13 – DELEGATED DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for portions of the work the design of which is delegated to the Contractor, including engineering services.
2. Additional delegated design requirements specific to a particular work result are specified within the appropriate specification Section.

B. Section Excludes:

1. Requirements for pre-engineered systems and assemblies.
2. Tested systems and assemblies pre-approved by the AHJ.

1.2 REFERENCES

A. Definitions:

1. Delegated: Means allocated by the Owner from the Architect to the Contractor.
2. Design: Means the complete planning, arrangement, and coordination of a discrete portion of the work, along with its graphic and written communication, including determination and engineering of the work's organization and structure in response to structural requirements, aesthetic requirements, functional requirements, dimensional and geometric limits; and the arrangement, performance, and other criteria indicated in the Contract Documents.
3. Delegated Design: Means the determination of which professional or party to a construction project carries the ultimate responsibility for the design of a discrete portion of the work. Other terms, including "design delegation", "design-build", and similar terms have the same meaning as "delegated design".
4. Category I Delegated Design: Means those delegated design services specifically required by the Contract Documents that relate to systems, materials, and equipment.
 - a. The Contractor shall design that particular portion of the work as required by the Contract Documents, provided the Architect specifies the minimum performance and design criteria that the Contractor must meet.
 - b. An example of Category I Delegated Design is the design of a cold-formed steel metal framing system, where the contractor is charged with meeting certain specified loading criteria.

5. Category II Delegated Design: Means those delegated design services that relate to the Contractor's means, methods, techniques and procedures of construction.
 - a. This category does not involve design services for the finished work, but instead the Contractor shall design services necessary to facilitate the construction process.
 - b. An example of Category II Delegated Design is the design of temporary shoring systems.
6. Engineering Services: Means those services performed by a qualified licensed professional engineer for the design of a discrete portion of the work, including fabrication, and installation of systems, assemblies, and components similar in material, design, complexity and extent to that indicated for this project.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Portions of the Contract Documents may delegate the design of certain items to the Contractor, or may otherwise specify "delegated design requirements" and similar terms.
- B. The Contractor is professionally liable for delegated design work, including design, engineering, fabrication, installation, and conformance to all specified performance requirements.
- C. Drawings of delegated design portions of the work are diagrammatic; they do not identify or imply solutions to engineering issues, and are intended only to show
 1. the design intent of finished materials, profiles, shapes and forms;
 2. relationships and alignments between items;
 3. location, identification, dimension, and size of components, assemblies, accessories, and other items; and
 4. schematic attachment details and diagrams of fasteners and connections.
- D. Specifications for delegated design portions of the work are the performance type, and establish the minimum allowable criteria for Contractor-selected and -designed materials, fabrications, products, systems, assemblies, and methods of execution; and minimum performance requirements for indicated portions of the work.
- E. The Architect reviews and determines whether or not the Contractor's designs
 1. generally conform to the overall project design;
 2. conform to the specified performance requirements, including subsequent modifications; and
 3. are acceptably integrated into the overall design of the project.
- F. In the event of a dispute regarding Contractor-proposed delegated design solutions and the design intent of the Contract Documents, the Architect's interpretation is final

1.4 PROCEDURAL REQUIREMENTS

- A. Design Requirements: Proposed delegated design solutions must demonstrate conformance to the original design intent indicated in the Contract Documents, as determined by the Architect.
 - 1. Unless otherwise defined by the Contract Documents, the appearance of exposed elements, including member sizes, profiles, and alignment of components must be
 - a. within the dimensional limits and section profiles indicated; and
 - b. consistent throughout the project.
 - 2. Deviation from the profiles, layouts, dimensional sizes, locations, or arrangements indicated is not permitted without prior written consent from the Architect; nor may the Contractor add or assume it may add items not indicated on the Contract Documents, including additional exposed supports, without prior written consent from the Architect.
 - 3. The Contractor may not infer or deduce solutions to design or engineering issues directly from the Contract Documents; Contractor-proposed delegated design solutions that exactly follow the details indicated on the Drawings do not relieve the Contractor from liability for the design and performance of any delegated design portion of the work.
- B. Engineering Requirements: Engineer delegated design portions of the work to
 - 1. meet or exceed the specified performance criteria;
 - 2. conform to the profiles indicated and to other requirements of the Contract Documents;
 - 3. satisfy the requirements of the AHJ; and
 - 4. provide structurally sound, leak-proof, non-corroding[, and weather tight] assemblies, as applicable, that accommodate, resist, distribute, or transfer, as applicable, the minimum specified in-service loads, and thermal, seismic, and wind sway, or other types of movement, without incipient or catastrophic failure.
- C. Regulatory Requirements: Delegated design portions of the work must be designed and engineered in conformance with the applicable portions of the California Building Code and other requirements of the AHJ.

1.5 SUBMITTALS

- A. General: Coordinate and process submittals for delegated design portions of the work in same manner as submittals for other portions of the work.
- B. Informational Submittals:
 - 1. Design Data: Submit engineering calculations demonstrating conformance to the requirements of the Contract Documents and the AHJ.
 - a. Calculations must be legible and incorporate sufficient cross-references to shop drawings to make calculations readily understandable and reviewable.
 - b. At a minimum, structural calculations must contain at least

- 1) an analysis of framing members;
 - 2) section property computations for framing members;
 - 3) an analysis of anchors, including anchors embedded in concrete; and
 - 4) the signature and seal of the qualified California-licensed professional structural engineer responsible for their preparation.
- c. Test reports are not an acceptable substitute for calculations.

1.6 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Must be legally qualified to practice in California with at least 10 consecutive years' experience providing engineering services on a weekly basis for projects similar in material, design, complexity, and extent to this project, and whose products have resulted in applications with a record of successful in-service performance.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide materials, fabrications, products, components, accessories, and other items required or necessary for a complete design, whether or not such items are indicated on the Drawings or in the Specifications.
- B. Provide anchors, attachments, inserts, fasteners, clips, bracing, framework, and other items as required or necessary to meet specified design and performance requirements; and to securely attach or fasten delegated design portions of the work to adjacent supports, or to related adjoining work, whether or not such items are indicated on the Drawings or in the Specifications.

PART 3 - EXECUTION

3.1 DESIGN

- A. General: Unless otherwise indicated or specified, maintain the visual concept shown, and conform to the design intent and all performance requirements indicated on the Drawings and in the Specifications, as determined by the Architect.
1. In the interest of certain fabrication or erection methods, minor dimensional changes and detailing adjustments to the original design communicated in the Contract Documents may become necessary.
 2. Obtain written approval from the Architect for proposed changes and adjustments before procurement, fabrication, manufacture, assembly, or installation, as applicable.

- B. Structural Design: Engage a qualified licensed professional structural engineer to design supports and connection details; and to determine fastener materials, types, sizes, and locations.
 - 1. Fasteners or connections may neither conflict with nor require revision to the finish profiles indicated; or to the supporting work.
 - 2. Connections may not impose eccentric loading, nor induce twisting or warping to supporting structures.
 - 3. Connections must be designed to accommodate potential and actual misalignment of adjacent work within normal, ordinary, and customary construction tolerances, and the tolerances specified in other Sections, whichever is more stringent.
- C. Mechanical Design: Engage a qualified licensed professional mechanical engineer to design fire sprinkler systems, unless another type of engineer is required by the Owner or the AHJ.
- D. Electrical Design: Engage a qualified licensed professional electrical engineer to design fire alarm systems, unless another type of engineer is required by the Owner or the AHJ.
- E. Earthwork Design: Engage a qualified licensed professional civil engineer to design soil retaining and other earthwork systems, unless another type of engineer is required by the Owner or the AHJ.

3.2 CATEGORY I DELEGATED DESIGN SCHEDULE

- A. Facility Construction Subgroup:
 - 1. Cold-formed metal framing specified in Section 05 40 00.
 - 2. Metal fabrications specified in Section 05 50 00.
 - 3. Metal roof panels specified in Section 07 41 13.
 - 4. Sheet metal flashings and trim specified in Section 07 62 00.
 - 5. Sliding storefronts specified in Section 08 43 33.
 - 6. Folding storefronts specified in Section 08 43 36.
 - 7. Curtain walls and glazed assemblies specified in Section 08 44 13.
 - 8. Glazing specified in Section 08 81 00.
 - 9. Suspension systems specified in Section 09 22 26.
- B. Facility Services Subgroup:
 - 1. Fire sprinkler systems specified in Section 21 13 00.
 - 2. Seismic bracing for mechanical, plumbing, and electrical equipment.
 - 3. Fire alarm systems specified in Section 28 31 00.

3.3 CATEGORY II DELEGATED DESIGN SCHEDULE

- A. Facility Construction Subgroup:
 - 1. Concrete formwork specified in Section 03 31 00.

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END OF SECTION
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SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 CONTRACT MODIFICATION PROCEDURES

- A. On Owner's approval of a proposal from Contractor on AIA Document G709, Architect will issue a Change Order on AIA Document G701, for all changes to the Contract Sum or the Contract Time.
- B. When Owner and Contractor disagree on the terms of a proposal, Architect may issue a Construction Change Directive on AIA Document G714, instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order. Construction Change Directive will contain a description of the change and designate the method to be followed to determine changes to the Contract Sum or the Contract Time.

1.2 PAYMENT PROCEDURES

- A. Submit a Schedule of Values before the 10th day of the following month for the Initial Application for Payment
- B. Break down the Contract Sum into at least one line item for each Specification Section in the Project Manual table of contents.
- C. Coordinate the Schedule of Values with Contractor's Construction Schedule.
 - 1. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 - 2. Provide separate line items in the Schedule of Values for initial cost of materials and for total installed value of that part of the Work.
- D. Submit (1) electronic copy for the application for payment, according to the schedule established in Owner/Contractor Agreement.
 - 1. With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
 - 2. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - a. List of subcontractors.
 - b. Schedule of Values.
 - c. Contractor's Construction Schedule (preliminary if not final).
 - d. Products list.
 - e. Submittals Schedule (preliminary if not final).
 - f. Copies of building permits.

- g. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - h. Initial progress report.
 - i. Certificates of insurance and insurance policies.
 - j. Performance and payment bonds.
 - k. Data needed to acquire Owner's insurance.
 - l. Initial settlement survey and damage report if required.
3. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
- a. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - b. Include consent of surety to final payment and insurance certificates.
 - c. Submit final meter readings for utilities, a record of stored fuel, and similar data as of the date of Substantial Completion.
 - d. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION



AIA[®] Document G710[™] – 1992

Architect's Supplemental Instructions

PROJECT: *(Name and address)*

ARCHITECT'S SUPPLEMENTAL
INSTRUCTION NUMBER:

OWNER ☐

ARCHITECT ☐

CONSULTANT ☐

CONTRACTOR ☐

FIELD ☐

OTHER ☐

OWNER: *(Name and address)*

DATE OF ISSUANCE:

CONTRACT FOR:

FROM ARCHITECT: *(Name and address)*

CONTRACT DATE:

TO CONTRACTOR: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

The Work shall be carried out in accordance with the following supplemental instructions issued in accordance with the Contract Documents without change in Contract Sum or Contract Time. Proceeding with the Work in accordance with these instructions indicates your acknowledgment that there will be no change in the Contract Sum or Contract Time.

DESCRIPTION:

ATTACHMENTS:

(Here insert listing of documents that support description.)

ISSUED BY THE ARCHITECT:

(Signature)

(Printed name and title)

CAUTION: You should sign an original AIA Contract Document, on which this text appears in RED. An original assures that changes will not be obscured.

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051711ACD44



Contract Administration

G709 Work Changes Proposal Request

(Instructions on the reverse side)

Distribution List:

Owner _____
Architect _____
Consultant _____
Contractor _____
Field _____
Other _____

PROJECT (Name and address):

PROPOSAL REQUEST NUMBER:

DATE OF ISSUANCE:

OWNER (Name and address):

CONTRACT FOR:

CONTRACT DATE:

FROM ARCHITECT (Name and address):

ARCHITECT'S PROJECT NUMBER:

TO CONTRACTOR (Name and address):

Please submit an itemized proposal for changes in the Contract Sum and Contract Time for proposed modifications to the Contract Documents described herein. Within _____ () days, the Contractor must submit this proposal or notify the Architect, in writing, of the date on which proposal submission is anticipated.

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE OR A DIRECTION TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

DESCRIPTION (Insert a written description of the Work):

ATTACHMENTS (List attached documents that support description):

REQUESTED BY THE ARCHITECT:

BY _____
(Signature)

(Printed name and title)

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CHANGE ORDER REQUEST (PROPOSAL)

Project: _____

Change Order Request Number: _____

From (Contractor): _____

To: _____

Date: _____

A/E Project Number: _____

Re: _____

Contract For: _____

This Change Order Request (C.O.R.) contains an itemized quotation for changes in the Contract Sum or Contract Time in response to proposed modifications to the Contract Documents based on Proposal Request No. _____.

Description of Proposed Change:

Attached supporting information from:

☐ Subcontractor ☐ Supplier ☐ _____ ☐ _____

Reason For Change:

Does Proposed Change involve a change in Contract Sum? ☐ No ☐ Yes [Increase] [Decrease] \$ _____

Does Proposed Change involve a change in Contract Time? ☐ No ☐ Yes [Increase] [Decrease] _____ days.

Attached pages: ☐ Proposal Worksheet Summary: _____

☐ Proposal Worksheet Detail(s): _____

Signed by: _____

Date: _____

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File



Contract Administration G701 Change Order

(Instructions on the reverse side)

Distribution List:

Owner _____
Architect _____
Contractor _____
Field _____
Other _____

PROJECT (Name and address):

CHANGE ORDER NUMBER:

DATE:

TO CONTRACTOR (Name and address):

ARCHITECT'S PROJECT NUMBER:

CONTRACT DATE:

CONTRACT FOR:

THE CONTRACT IS CHANGED AS FOLLOWS:

(Include, where applicable, any undisputed amount attributable to previously executed Construction Change Directives)

The original (Contract Sum) (Guaranteed Maximum Price) was \$ _____
The net change by previously authorized Change Orders \$ _____
The (Contract Sum) (Guaranteed Maximum Price) prior to this Change Order was \$ _____
The (Contract Sum) (Guaranteed Maximum Price) will be (increased) (decreased) (unchanged) by this Change Order in the amount of \$ _____
The new (Contract Sum) (Guaranteed Maximum Price) including this Change Order will be \$ _____
The Contract Time will be (increased) (decreased) (unchanged) by _____ () days.
The date of Substantial Completion as of the date of this Change Order therefore is _____

NOTE: This Change Order does not include changes in the Contract Sum, Contract Time or Guaranteed Maximum Price which have been authorized by Construction Change Directive until the cost and time have been agreed upon by both the Owner and Contractor, in which case a Change Order is executed to supersede the Construction Change Directive.

NOT VALID UNTIL SIGNED BY THE ARCHITECT, CONTRACTOR AND OWNER.

ARCHITECT (Firm name)

CONTRACTOR (Firm name)

OWNER (Firm name)

ADDRESS

ADDRESS

ADDRESS

BY (Signature)

BY (Signature)

BY (Signature)

(Typed name)

(Typed name)

(Typed name)

DATE

DATE

DATE

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Contract Administration

G714 Construction Change Directive

Distribution List:

Owner _____
Architect _____
Consultant _____
Contractor _____
Field _____
Other _____

PROJECT (Name and address):

DIRECTIVE NUMBER:

DATE:

CONTRACT FOR:

CONTRACT DATE:

ARCHITECT'S PROJECT NUMBER:

You are hereby directed to make the following change(s) in this Contract:
(Describe briefly any proposed changes or list any attached information in the alternative)

PROPOSED ADJUSTMENTS

1. The proposed basis of adjustment to the Contract Sum or Guaranteed Maximum Price is:

- Lump Sum (increase) (decrease) of \$ _____
- Unit Price of \$ _____ per _____
- As provided in Subparagraph 7.3.3 of AIA Document A201-1997
- As follows:

2. The Contract Time is proposed to (be adjusted) (remain unchanged). The proposed adjustment, if any, is
(an increase of _____ days) (a decrease of _____ days).

When signed by the Owner and Architect and received by the Contractor, this document becomes effective IMMEDIATELY as a Construction Change Directive (CCD), and the Contractor shall proceed with the change(s) described above.

Contractor signature indicates agreement with the proposed adjustments in Contract Sum and Contract Time set forth in this CCD.

ARCHITECT (Firm name)

OWNER (Firm name)

CONTRACTOR (Firm name)

ADDRESS

ADDRESS

ADDRESS

BY (Signature)

BY (Signature)

BY (Signature)

(Typed name)

(Typed name)

(Typed name)

DATE

DATE

DATE

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SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for substitutions.

1.2 REFERENCES

A. Definitions:

1. Substitutions: Means Contractor-suggested changes to products, materials, equipment, systems, assemblies, and methods of construction from those required by the Contract Documents to similar items that are not necessarily identical, but are still alike with respect to appearance and performance.
2. Proposed Substitutions: Means those substitutions proposed and considered during the bidding period, provided the bidder indicates the difference in cost that results if a substitution request is accepted.
 - a. Bid prices for each substitution request include all costs required to incorporate the substitution into the project.
 - b. Later requests for additional costs for substitutions are not considered.
3. Controlled Substitutions: Means those substitutions that are allowed under procedures specified in this Section.
 - a. Substitutions for Cause: Means those Contractor- suggested changes resulting from changing project conditions, such as product unavailability, regulatory change, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Means those Contractor- and Owner- suggested changes that are not necessary to meet project requirements, but that may offer an advantage to the Contractor or the Owner.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Substitution Requests:

1. The Owner and the Architect consider only formal requests for substitution prepared by the Contractor on an approved substitution request form, for items and fabrication or installation methods in lieu of those specified when
 - a. in the opinion of the Contractor, the specified product or process will not fulfill the design intent; or
 - b. the Contractor ascertains the specified product is unavailable, as evidenced by written documentation that firm orders were placed in a timely manner; or that the unavailability is due to strike, lockout, bankruptcy, discontinuance of manufacture, or an act of God.
2. The Owner and the Architect do not consider substitutions when

- a. indicated or implied on RFIs, or on shop drawing or project data submittals, without additional requests submitted on an approved substitution request form in conformance with the requirements of this Section;
 - b. requested directly by a subcontractor or supplier; and
 - c. acceptance requires substantial revision of Contract Documents.
3. By issuing a substitution request, the Contractor represents that
 - a. the Contractor has investigated the substitute item or method, and has determined that it is equal to, or superior, in all respects, to the originally-specified item or method;
 - b. the same warranties are provided for the substitution request item or method as the originally-specified item or method, without exception or limitation;
 - c. the Contractor shall coordinate the installation of accepted substitutions into the Work, making such changes to adjacent materials as required to make the Work complete in all respects, without re-design of adjacent items and supporting materials;
 - d. the Contractor waives all claims for extensions of time or time/sequence related intended or unintended consequences, including additional costs that subsequently arise;
 - e. all cost data is complete, and includes all related costs under the Contractor's Contract, but excludes development and implementation costs incurred by the Owner and the Architect.
- B. Compatibility: Investigate and document the compatibility of substitutions with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended or required by the manufacturers.
- C. Approval or Rejection: Approval or rejection of a substitution is at the Owner's and the Architect's sole discretion, which is final; and includes consideration of the following factors, among others, in comparing the equality of substitutions with all originally-indicated or -specified requirements.
 1. The quality of materials, structural strength, construction, fabrication, and performance.
 2. Final appearance, finishes, and surface characteristics.
 3. The supplier's, fabricator's, manufacturer's history, track record, or reputation.
 4. Impact on adjoining or related work. Arrangements resulting in acceptance a substitution include equal in appearance, convenience, and practicality to original arrangements.
 5. Availability of replacement parts and maintenance services.
 6. Ease of maintenance, repair, cleaning, adjusting, and re-finishing.
 7. Code approvals and service history.
- D. Resubmittal: Do not resubmit previously-rejected substitution requests in a modified form.
 1. Upon rejection of a substitution request, the Contractor may submit a different substitution within the specified time limits.

2. If a second a substitution request is rejected or is not received by the Architect within specified time limits, provide the original item or method as specified, and without substitution.
- E. Conformance: Acceptance of substitution requests does not relieve the Contractor from conformance to the Contract Documents. The Contractor bears all additional expenses resulting from approved substitutions, and those expenses resulting from approved substitutions affecting adjoining or adjacent work.
- F. Unauthorized Substitutions: Substitute items installed without prior written approval are considered defective work. At no additional cost to the Owner, remove and replace defective work and install the originally-specified item.

1.4 SUBMITTALS

- A. Substitution Requests: Submit for consideration 3 copies of each substitution request. Identify originally-specified and substitution request items, or fabrication or installation methods. Include the specification Section number and title, and the Drawing numbers and titles.
 1. Substitution Request Form: Use CSI Form 13.1A.
 2. Documentation: Submit the following, as applicable, as evidence that a substitution request conforms to the originally-specified requirements.
 - a. A statement indicating why the specified item or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes, modifications, or revisions to other parts of the work, and to construction performed by the Owner and separate contractors, that is necessary to accommodate the substitution request.
 - c. A detailed line-by-line comparison of significant qualities, salient properties, and performance of the substitution request with the originally-specified items. Include an annotated copy of the applicable Specification section.
 - 1) Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated.
 - 2) Indicate deviations, if any, from the specified requirements.
 - 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. A list of similar installations for completed projects with project names and addresses, and the names and addresses of the architects and owners.
 - h. Material test reports issued by a qualified testing agency indicating and interpreting test results for conformance to the specified requirements.
 - i. Research reports issued by ICC-ES evidencing conformance with the building code in effect for project,.
 - j. A detailed comparison of the Contractor's construction schedule using the substitution request versus the specified items, including the overall effect on the

Contract Time. If the specified item or method of construction cannot be provided within the Contract Time, include a letter from manufacturer, on manufacturer's letterhead, stating the date of receipt of the purchase order, lack of availability, or delays in delivery.

- k. Cost information, including a proposal for change, if any, to the Contract Sum.
 - l. The Contractor's certification that the substitution request conforms to the requirements of the Contract Documents, except as indicated in the substitution request; is compatible with related materials; and is appropriate for the applications indicated.
 - m. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of the substitution request to produce indicated results.
3. Architect's Action: When necessary, the Architect requests additional information or documentation for evaluation within 7 calendar days of receiving a substitution request. The Architect notifies the Contractor of acceptance or rejection of the substitution request within 15 business days of receipt of receiving a substitution request, or within 7 calendar days of receiving additional information or documentation, whichever is later.
- a. A Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the work must be issued as acceptance of a substitution request. No exceptions.
 - b. Provide the originally-specified item or method if the Architect does not make a decision on the use of a substitution request within time allocated for a response.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. General:

- 1. Failure of the Contractor to submit substitution requests for approval in the manner indicated above and within the prescribed time indicated below is sufficient cause for the Architect to reject such substitution.
- 2. If a substitution request is submitted after the time periods indicated below, the Architect, at its sole discretion, may still agree to review such substitution, in which case the Architect's reasonable expenses for such reviews are to be paid by the Contractor and are deducted from the Contract Sum, as approved by Owner.

B. Substitutions for Cause: Submit requests for substitution promptly upon discovery of a perceived need for change, but at least 15 business days before to the time required to prepare and review of related submittals.

- 1. The Architect considers the Contractor's request for substitution only when all of the following conditions are satisfied. If the following conditions are not satisfied, the Architect returns requests for substitution without action, except to record nonconformance with these requirements.

- a. The requested substitution conforms to the Contract Documents and produces the indicated results.
 - b. The requested substitution provides sustainable design characteristics that the specified product provided.
 - c. The requested substitution is fully documented on the approved substitution request form and properly submitted.
 - d. The requested substitution does not adversely affect the Contractor's construction schedule.
 - e. The requested substitution has all current and necessary approvals from the AHJ.
 - f. The requested substitution is compatible in all respects with other portions of the work.
 - g. The requested substitution is fully-coordinated with other portions of the work.
 - h. The requested substitution provides the minimum specified warranty or warranties.
2. If the requested substitution involves more than one contractor, then the requested substitution is also
 - a. coordinated with other portions of the work;
 - b. uniform and consistent;
 - c. compatible with other products; and
 - d. acceptable to all other involved contractors.

C. Substitutions for Convenience: Not permitted.

PART 3 - EXECUTION (NOT USED)

END OF SECTION



SUBSTITUTION REQUEST

(During the Bidding Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____
Signed by: _____
Firm: _____
Address: _____

Telephone: _____

A/E= s REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____

Date: _____

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



SUBSTITUTION REQUEST

(During the Construction Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

☐ Point-by-point comparative data attached - REQUIRED BY ARCHITECT

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

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

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

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

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

SUBSTITUTION REQUEST

(During the Construction Phase – Continued)

The Undersigned certifies:

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

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

ARCHITECT'S REVIEW AND ACTION

- ☐ Substitution approved - Make submittals in accordance with Specification Section 01 33 00.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 0133 00.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____

Date: _____

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

SECTION 01 26 13 – REQUESTS FOR INTERPRETATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for RFIs.

1.2 REFERENCES

- A. Abbreviations and Acronyms:

- 1. RFI: Contractor's Requests for Interpretation.

- B. Definitions:

- 1. Reasonably Inferable: Means that if an item, system, or assembly, including components, accessories, and facility services, is either indicated or specified, then all material, labor, equipment, and facility services that are (a) normally furnished with such items, systems, or assemblies; and (b) that are necessary to make a complete installation, must be provided whether or not indicated or specified.
 - a. Only items specifically excepted may be omitted from the project.
 - b. Items the Contractor could or should have reasonably anticipated must be included in the project, based on (1) the Contractor's skill, knowledge, and experience; and (2) using an objective industry standard and not a subjective standard.
 - 2. Request for Interpretation: Means the procedure used by the Owner or the Contractor when it is necessary to confirm the interpretation of a detail, specification or note on the Drawings; or to secure a documented directive or clarification from the Architect that is needed in executing the work. Other terms, including "request for information" and similar terms, have the same meaning as "request for interpretation".

1.3 REQUIREMENTS

- A. Submit an RFI to the Architect when

- 1. an unforeseen condition occurs;
 - 2. questions regarding design intent of the Contract Documents or constructability arise;
 - 3. clarification of information contained within the Contract Documents, or supplementary information not contained within the Contract Documents, is required; and
 - 4. an interpretation of the Contract Documents, including that of apparent conflicts, is necessary.

- B. When possible, request interpretations either verbally or in writing at the next scheduled project meeting.
 - 1. When an RFI is answered at the project meeting, enter the response into the meeting minutes.
 - 2. When the urgency of need, or the complexity of an item makes clarification at the next scheduled project meeting impractical, then promptly prepare and submit to the Architect a formal written RFI.
- C. Do not use RFIs to
 - 1. request contract modifications;
 - 2. confirm actions taken by the Contractor for requested contract modifications;
 - 3. request approval of submittals; and
 - 4. request approval of substitutions.

1.4 SUBMITTALS

- A. Direct RFIs to the Architect by hand carry, mail, overnight express delivery, facsimile (fax), messenger, email, project management software, or otherwise as appropriate.
 - 1. The Contractor's shall verify the Architect has received all RFIs.
 - 2. RFIs generated by subcontractors or material suppliers must be submitted through the Contractor; and must be thoroughly reviewed by the Contractor prior to submittal to the Architect. If the Contractor does not thoroughly review an RFI before submitting it to the Architect, the Architect returns the RFI without action, except to record nonconformance with these requirements.
 - 3. RFIs received directly from a subcontractor are returned to the Contractor without action, except to record nonconformance with these requirements.
- B. The Owner or the Contractor may issue an RFI to the Architect via CSI Form 13.2A, "Request for Interpretation."
- C. The Architect considers the Contractor's request for interpretation only when all of the following conditions are satisfied. If the following conditions are not satisfied, the Architect returns requests for substitution without action, except to record nonconformance with these requirements. The RFI must include
 - 1. the project name matching that listed on the Contract Documents; and the Architect's project number or other identifying number, if any.
 - 2. the date the RFI is submitted (not the date the RFI was generated).
 - 3. the Contractor's name, address, telephone, and fax numbers.
 - 4. the Drawing numbers and detail references, where appropriate.
 - 5. the Section number and title of all affected specification Section or Sections.
 - 6. a clear and concise question, and a summary and explanation of the question these are not self-evident.
 - 7. the Contractor-recommended solution or response to the requested interpretation or clarification.

8. a blank space for the Architect's written response.
- D. Submit RFIs within a reasonable time frame so as not to interfere with or impede the progress of the work. When the number and frequency of RFIs submitted becomes unwieldy, the Architect may recommend the Contractor abandon the process and submit requests as substitutions conforming to the requirements of Section 01 25 00; as change order requests conforming to the requirements of Section 01 20 00; or as submittals conforming to the requirements of Section 01 30 00.
 1. Consecutively number submitted RFIs. Each page of the RFI and every attachment to the RFI must also bear the RFI number.
 2. When the Contractor anticipates that the Architect's written response to an RFI might necessitate a change the Contract Sum or Contract Time, a properly executed Change Order Proposal Request conforming to the requirements of Section 01 20 00 must be submitted along with the RFI.
- E. Allow at least 5 business days in the Contractor's construction schedule for review and response time for each RFI, unless additional time is requested or needed. The response time is increased when
 1. more information from the Contractor is requested by the Architect;
 2. the RFI is submitted out-of-sequence; or
 3. in the opinion of the Architect, more time is needed to respond to the RFI.
 - a. The Contractor shall alert the Architect in writing of the time available before a response may cause an impact to the Contract Sum or Contract Time.
 - b. Failure of the Contractor to alert the Architect in writing inures to the benefit of the Architect.
- F. When the Architect requires clarification to any RFI, then the period of time allotted for the Architect's response begins when the Architect receives from the Contractor all requested information.
- G. The Contractor shall prepare and maintain an RFI log.
 1. At a minimum, the RFI log must include RFI numbers, brief descriptions of content or subjects discussed, dates the RFIs are submitted to the Architect, and dates the Architect's responses are received (not the date the RFI was closed-out).
 2. The Contractor shall keep the RFI log current, and shall furnish a copy to the Owner or Architect whenever requested.

1.5 QUALITY ASSURANCE

- A. Before submitting RFIs to the Architect, verify the interpretation requested is not indicated in the Contract Documents, or cannot be determined from a careful review of the Contract Documents.
 1. Carefully study the Contract Documents to ensure requested interpretations are not reasonably inferable therein.

2. RFIs requesting interpretations reasonable inferable from the Contract Documents are returned to the Contractor without review, except to record nonconformance with this requirement.
- B. Where field conditions may dictate solutions, provide both an assessment of the potential problem and a suggested solution with each RFI submitted. RFIs that do not include a suggested solution may be returned to the Contractor without review, except to record nonconformance with this requirement.
- C. When an RFI is used to request clarification to coordination issues (e.g. pipe and duct routing, clearances, specific locations of work shown diagrammatically, and similar items) the Contractor shall suggest a solution using drawings or sketches drawn to scale, and then submit them as attachments to the RFI.
 1. The Architect reviews only those RFIs that include a suggested solution to a request.
 2. If no apparent solution is obvious, then a statement to that effect must be added to the RFI in lieu of a suggested solution.
- D. When the Contractor believes that an Architect's written response to an RFI might necessitate a change the Contract Sum or Contract Time, the Contractor shall notify the Owner in writing within 5 business days of receiving the Architect's response.
 1. RFI responses are not approvals to perform additional or extra work.
 2. When the Contractor believes that an Architect's written response to an RFI might necessitate a change the Contract Sum or Contract Time, the Contractor shall provide evidence supporting the basis of the Contractor's estimates changes as they relates to the RFI.
 3. The Contractor may not proceed with any additional or extra work indicated by the RFI response until a Change Order or other acceptable modification is properly prepared, submitted, and executed in conformance with the requirements of Section 01 25 00.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION



REQUEST FOR INTERPRETATION

Project:	_____	R.F.I. Number:	_____
	_____	From:	_____
To:	_____	Date:	_____
	_____	A/E Project Number:	_____
Re:	_____	Contract For:	_____

Specification Section:	Paragraph:	Drawing Reference:	Detail:
------------------------	------------	--------------------	---------

Request:

Contractor's suggested response or solution:

Signed by:

Date:

Architect's Response:

☐ Attachments

Response From:	To:	Date Rec'd:	Date Ret'd:
----------------	-----	-------------	-------------

Signed by:

Date:

Copies: ☐ Owner ☐ Consultants ☐ _____ ☐ _____ ☐ _____ ☐ _____ ☐ File

SECTION 01 30 00 – ADMINISTRATIVE REQUIRMENTS

PART 1 - GENERAL

1.1 PROJECT MANAGEMENT AND COORDINATION

- A. Coordinate construction to ensure efficient and orderly installation of each part of the Work.
- B. Before beginning work, schedule a preconstruction meeting at the project site or another convenient location to review responsibilities and personnel assignments, Require attendance of the Owner's authorized representative, Architect and the Architect's consultants, Contractor and the Contractor's superintendent, major subcontractors and material suppliers and other concerned parties.
- C. Schedule and conduct progress meetings at Project site at intervals. Notify Owner and Architect of meeting dates and times. Require attendance of each subcontractor or other entity concerned with current progress or involved with planning or coordination of future activities.
- D. Record minutes and distribute to everyone concerned, including Owner and Architect.

1.2 SUBMITTAL PROCEDURES

- A. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 1. Allow for a minimum of 15 business days for Architect's review of submittals. 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.
 - 2. Submit one electronic copy of each submittal to Architect. Provide 4 copies of samples.
 - 3. Architect will discard submittals received from sources other than Contractor.
- B. Place a permanent label or title block on each submittal for identification. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect. Include the following information on the label:
 - 1. Project name.
 - 2. Date.
 - 3. Name and address of Contractor.
 - 4. Name and address of subcontractor or supplier.
 - 5. Number and title of appropriate Specification Section.

- C. Identify deviations from the Contract Documents on submittals.
- D. Contractor's Construction Schedule Submittal Procedure: Submit 2 copies of schedule within 15 days after date established for Commencement of the Work.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. Product Data: Mark the electronic copy to show applicable products and options. Include the following:
 - 1. Manufacturer's written recommendations, product specifications, and installation instructions.
 - 2. Wiring diagrams showing factory-installed wiring.
 - 3. Printed performance curves and operational range diagrams.
 - 4. Testing by recognized testing agency.
 - 5. Compliance with specified standards and requirements.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Submit on electronic sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches. Include the following:
 - 1. Dimensions and identification of products.
 - 2. Fabrication and installation drawings and roughing-in and setting diagrams.
 - 3. Wiring diagrams showing field-installed wiring.
 - 4. Notation of coordination requirements.
 - 5. Notation of dimensions established by field measurement.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 - 1. Include name of manufacturer and product name on label.
 - 2. If variation is inherent in material or product, submit at least 3 sets of paired units that show variations.

2.2 INFORMATION SUBMITTALS

- A. Qualification Data: Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type schedule in P6 format within 15 days of date established for the Notice to Proceed.

- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

PART 3 - EXECUTION

3.1 SUBMITTAL REVIEW

- A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Architect will review each action submittal, make marks to indicate corrections or modifications required, stamp and mark as appropriate to indicate action taken, and return copies less those retained.

3.2 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Distribute copies of approved schedule to Owner, Architect, subcontractors, testing and inspecting agencies, and parties identified by Contractor with a need-to-know schedule responsibility. When revisions are made, distribute updated schedules to the same parties.
- B. Updating: At weekly intervals, update schedule to reflect actual construction progress and activities.
 - 1. Issue schedule at least 3 business days before each regularly scheduled progress meeting.
 - 2. As the Work progresses, indicate Actual Completion percentage for each activity.

END OF SECTION

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. 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. Testing and inspecting services are specified in other Sections of these Specifications or are required by authorities having jurisdiction and shall be performed by independent testing agencies.
 - 2. Where quality-control services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these services.
 - 3. Contractor is responsible for scheduling times for tests, inspections, and obtaining samples and notifying testing agency.
 - 4. Retesting and Reinspecting: Contractor shall pay for additional testing and inspecting required as a result of tests and inspections indicating noncompliance with requirements.

1.2 SECTION REQUIREMENTS

- A. Submittals: Testing agency shall submit a certified written report of each test and inspection to Owner, Contractor, Architect, and to authorities having jurisdiction when they so direct. Reports of each inspection, test, or similar service shall include the following:
 - 1. Name, address, and telephone number of testing agency.
 - 2. Project title and number.
 - 3. Date of issue.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
 - 6. Names of individuals making tests and inspections.
 - 7. Description of the Work and test and inspection method.
 - 8. Complete test or inspection data, test and inspection results, an interpretation of test results, and comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 9. Recommendations on retesting and reinspecting.
 - 10. Name and signature of inspector.

- B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated; and where required by authorities having jurisdiction, that is acceptable to authorities.

1.3 EXECUTION

- A. Testing Agency Responsibilities: Testing agency shall cooperate with Architect and Contractor in performing its duties and shall provide qualified personnel to perform inspections and tests.
 - 1. Agency shall promptly notify Owner, Architect and Contractor of irregularities or deficiencies in the Work observed during performance of its services.
 - 2. Agency shall not release, revoke, alter, or increase requirements of the Contract Documents nor approve or accept any portion of the Work.
 - 3. Agency shall not perform any duties of Contractor.
- B. Auxiliary Services: Cooperate with testing agencies and provide auxiliary services as requested, including the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of materials for testing, and assistance in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Security and protection for samples and for testing and inspecting equipment.
- C. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction.
- D. 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.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 00 – REFERENCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for
 1. specification format and conventions;
 2. abbreviations and acronyms used throughout the Contract Documents; and
 3. definitions used throughout the Contract Documents.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Abbreviations and Acronyms:
 1. Certain abbreviations and acronyms contained in the Contract Documents are defined particularly for these specifications.
 2. Where acronyms are not defined, they mean the recognized name of the standard, regulation, or organization indicated in either
 - a. "Encyclopedia of Associations: National Organizations of the U.S." published by Gale/CENGAGE Learning; or
 - b. "National Trade and Professional Associations of the United States" published by Columbia Books & Information Services.
- B. Definitions:
 1. Basic Contract Document definitions are included in the Conditions of the Contract.
 2. Certain other terms, phrases, and words, and their derivatives, contained in the Contract Documents are defined particularly for these specifications in either this Section or within the appropriate specification section where a specific term is used.
 3. Where terms, phrases, or words, and their derivatives and abbreviations, are not defined, their ordinary meanings indicated in "Webster's Third New International Dictionary of the English Language, Unabridged", copyright 1986, are assumed to apply as the context of usage requires.
 4. Words implied, but not stated, are inferred as the context of usage requires.
 5. Terms, phrases, and words used in the neuter gender include the feminine and the masculine; the masculine gender includes the feminine and neuter; and the feminine gender includes the masculine and neuter. Similarly, when the context requires, the singular includes the plural, and the plural the singular.
 6. Underlined, bold, or capitalized words do not signify, imply, or convey any special or unusual meaning; nor do they signify, imply, or convey that words not underlined, bolded, or capitalized have any less meaning.

1.3 REFERENCES

A. Abbreviations:

1. deg.: Degree.
2. O.C.: On-center.

B. Acronyms:

1. AA: Aluminum Association
2. AAMA: the Architectural Aluminum Manufacturer's Association
3. AHJ: Authority (Authorities) Having Jurisdiction
4. AISI: American Iron and Steel Institute
5. ANSI: American National Standards Institute
6. ASTM: American Society for Testing and Materials
7. AWS: American Welding Society
8. CARB: California Air Resources Board
9. CFS: Cold-Formed Steel.
10. CHPS: The Collaborative for High Performance Schools
11. CRI: Carpet and Rug Institute
12. DFT: Dry Film Thickness
13. DSA: Division of the State the Architect
14. EPA: U.S. Environmental Protection Agency.
15. FSC: Forest Stewardship Council
16. FSI: Flame Spread Index
17. GEI: GREENGUARD Environmental Institute
18. HDG: Hot Dip Galvanized
19. IOR: Inspector of Record
20. LEED: Leadership in Energy and Environmental Design
21. NFPA: National Fire Protection Association.
22. OSHPD: Office of Statewide Health Planning and Development
23. HDG: Hot Dip Galvanized
24. MFMA: Metal Framing Manufactures Association
25. MSG: Manufacturer's Standard Gage
26. NOMMA: National Ornamental Metals Manufacturer's Association
27. SC: Service Condition
28. SCAQMD: South Coast Air Quality Management District
29. SCS Scientific Certification Systems
30. SDI: Smoke Developed Index
31. SSMA: Steel Stud Manufacturing Association
32. SSPC: Society for Protective Coatings.
33. SWG: Standard Wire Gage

- 34. TCA: Tile Council of America
- 35. UBC: Uniform Building Code.
- 36. UL: Underwriters Laboratories.
- 37. USGBC U.S. Green Building Council

C. Definitions:

- 1. **Aboveground:** Means situated completely on or above the final finish grade or surface of the ground, or finish floor of grade-level floor construction. Other terms, including "above grade" and similar terms have the same meaning as "aboveground". Locations that do not meet the definition above for "aboveground" are considered "below ground" or "below grade", and similar locations.
- 2. **Appearance:** Means the characteristic visible aspect of an item; specifically its color, sheen, and texture.
- 3. **Approved:** Means recognized in writing by the Architect as in conformance with the requirements of the Contract Documents. Other terms, including "approve", "approval", and similar terms, have the same meaning as "approved".
 - a. Approvals are restricted to limitations of the Architect's responsibilities and duties outlined in the Conditions of the Contract, without any implied meaning extending the Architect's responsibility into the Contractor's area of the Contractor coordination, supervision, or means and methods of construction as outlined in the Conditions of the Contract.
 - b. In no situation does an approval by the Architect release the Contractor from responsibility to fulfill all requirements of the Contract Documents.
- 4. **Approved Substitute:** Means a substitution proposed and evidenced by the Contractor as either in compliance with or exceeding the quality of specified products, systems or methods of execution relative to appearance, convenience and practicality, including product considerations, manufacturer considerations, manufacturer's product representative considerations, installation considerations and cost considerations, and approved by the Architect for incorporation into the work.
- 5. **As Indicated:** Means shown on the Contract Drawings.
- 6. **As Necessary:** Means essential to the completion of the work.
- 7. **As Required:** Means either (a) as instructed by the Contract Documents or (b) essential to the completing the work.
- 8. **Assembly:** A composite entity composed of various parts fit together in an orderly way, usually with logical selection or sequence, so as to make into an operative whole (e.g., a stair or curtain wall assembly)
- 9. **Authority (Authorities) Having Jurisdiction:** Means the agencies, either individually or collectively, charged by statute with administration and enforcement of building code requirements and other regulations at the project location.
- 10. **Below Ground:** See definition of "Aboveground".
- 11. **Board:** Means sawn timber measuring less than 2 inches in nominal thickness at the least dimension.
- 12. **Building Information Model:** Means digital computer data used by the Architect as instruments of service to produce Contract Documents, including 2-dimensional and

3-dimensional computer model and drawing files in CAD format, and spreadsheet or word processing files.

13. **Cold-Formed Metal Framing:** Means structural metal framing members having a base metal thickness range of between 118 mils (10-gage) and 33 mils (20-gage), and installed in transverse and axial load-bearing applications.
14. **Concealed:** Means embedded in concrete, masonry or other construction; located or installed within furred spaces; situated within walls or partitions; suspended above ceilings; or placed in trenches, crawl spaces, or enclosures; or otherwise not visible, either outside the building or inside occupied space within the building, during normal activity when the project is completed; or that is identified as exposed on Drawings.
15. **Component:** One of a group of individual parts of which a subassembly, assembly or system is comprised; especially a part that can be separated from or attached to the group.
16. **Concealed:** See definition for "Exposed".
17. **Day:** Basic reference to the primary unit of Contract time. If not specifically designated as either a calendar or a business day, the generic term "day" is taken to mean a calendar day.
 - a. **Calendar Day:** Means a period of time occurring Monday, Tuesday, Wednesday, Thursday, Friday, Saturday or Sunday, and beginning at 00:00:00 local project time and ending at 23:59:59 local project time.
 - b. **Holiday:** Means a federally-recognized holiday listed by the United States Government's Office of Personnel Management (i.e., New Year's Day, Birthday of Martin Luther King, Jr., Washington's Birthday, Memorial Day, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, and Christmas Day).
 - c. **Business Day:** Means a non-holiday period of time occurring Monday, Tuesday, Wednesday, Thursday, or Friday, and beginning at 08:00:00 local project time and ending at 17:00:00 local project time. Events occurring after 17:00:00 are charged to the next consecutive business day.
 - d. **Week:** Means 7 consecutive calendar days, inclusive.
 - e. **Year:** Means 365 consecutive calendar days, inclusive.
18. **Defective:** Means a product, system, or method of execution that has failed, or that otherwise does not comply with the requirements of the Contract Documents. Other terms, including "defect", "defective work", and similar terms, have the same meaning as "defective". See definition for "failure" for a partial list of defects, which are not limited to those indicated.
19. **Dimension Lumber:** Means sawn timber measuring between 2 and 5 inches in nominal thickness at the least dimension.
20. **Directed:** Means a written instruction issued by the Architect to the Contractor. Other terms, including "authorized", "permitted", "requested", and similar terms, have the same meaning as "directed".
21. **Enclosure:** Means a level of protective resistance to weather for interior spaces provided during the construction phase by either permanent construction or substantial temporary closures. Other terms, including "enclosed" and similar terms, have the same meaning as "enclosure".

- a. **Uncontrolled Enclosure:** Means short-term, limited, temporary protection against wind for up to 6 months before completion of the permanent enclosure, as determined by the Architect.
 - b. **Partially-Controlled Enclosure:** Means medium-term, limited, temporary protection against both wind and rain for up to 12 months before completion of the permanent enclosure, as determined by the Architect.
 - c. **Permanent Enclosure:** Means complete permanent protection against wind, temperature, humidity, atmospheric pressure, and precipitation, provided by a permanent insulated and weathertight roofing system, permanent insulated and weathertight exterior wall construction, and openings closed with permanent construction or substantial temporary closures equivalent in protection to permanent construction, as determined by the Architect.
22. **Engineering Services:** Means those services performed for the design, fabrication and installation of components and assemblies similar in material, design, complexity and extent to those indicated or required for this project.
23. **Equipment:** Means a product with operational parts and controls, whether motorized or manually operated, that requires service connections including wiring, piping or similar connections.
24. **Ex situ:** Means either off-site or away from the position an item will ultimately occupy.
25. **Existing Products:** Means an item salvaged or recycled from the project, or from another project or facility, where indicated, and incorporated into the work.
26. **Exposed:** Means an item that either does not meet the definition above for “concealed”, or that is identified as exposed on Drawings.
- a. **Weather-Exposed:** Means a floor, wall, soffit, ceiling, roof or similar surface that is exposed to unconditioned wind, temperature, humidity, atmospheric pressure or precipitation, except
 - 1) ceilings or roof soffits enclosed by walls or by beams that extend at least 12 inches below such ceilings or roof soffits;
 - 2) walls or portions of walls within an enclosed roof area when located a horizontal distance from an exterior opening equal to twice the height of the opening; and
 - 3) ceiling or roof soffits beyond a horizontal distance 10 feet from the outer edge of the ceiling or roof soffits.
27. **Exterior:** See definition below for “interior”.
28. **Fabricate:** Means to specifically assemble, or make out of selected materials, to meet individual requirements for the project. Other terms, including “fabrication”, “fabricator” and similar terms, have the same meaning as “fabricate”.
29. **Factory finished:** Means finished off the project site under controlled environmental conditions, requiring no additional finish at the project site except for minor touchup of areas damaged during delivery, storage, handling and installation. Other terms, including “shop-applied”, “prefinished”, and similar terms, have the same meaning as “factory finished”.

30. **Failure:** Means the inability of an item, system, assembly, or method of execution to perform its intended function as designed, including incipient and catastrophic failure.
- a. **Incipient Failure:** Means initial or nascent non-catastrophic failure of a product or system, or a method of execution leading to such a failure, including
- 1) excessive material loss due to abrasion resulting from normal traffic;
 - 2) cracking, flaking, spalling, or eroding in excess of specified requirements;
 - 3) peeling or delaminating from substrate;
 - 4) staining of adjacent surfaces caused by migration of materials, components or accessories;
 - 5) buckling, deflection, or other structural performance exceeding the specified limits;
 - 6) performance either exceeding maximum specified performance requirement limits or falling below minimum specified performance requirement limits;
 - 7) stresses transferred from supporting framing members to other items that are not engineered to support or resist the transferred loads;
 - 8) material fatigue, including deterioration, cracking or brittleness, identified by inspection, data analysis or other means of detection;
 - 9) displacement of glazing gaskets;
 - 10) loosening, weakening, or permanent damage to fasteners, anchors, attachments and other components; and
 - 11) vibration or noise caused by thermal or structural movement, or wind, including rattle and flutter.
- b. **Catastrophic Failure:** Means discernible failure impossible to acceptably remedy or correct in place, or that necessitates remedial repair, in each case as determined by the Architect, including
- 1) buckling, deflection, or other structural performance necessitating remedial repair;
 - 2) failure of operable units to open or close, or to otherwise achieve the full range of design movement;
 - 3) permanent deformation of any material or component exceeding specified limits;
 - 4) breakage or fallout from an assembly of any material or component;
 - 5) air infiltration or water leakage;
 - 6) material adhesive or cohesive failure, including tearing;
 - 7) corrosion, staining or other deleterious effects due either to physical contact of dissimilar metals or to water runoff passing over dissimilar metals;
 - 8) water leakage;
 - 9) loss of waterproofing integrity, allowing the intrusion of water, oils, gasoline, grease, salt, chemicals, acids or other fluids to outside surface of substrate; and
 - 10) chalking or color changes relative to a control sample of the original application beyond those described in manufacturer-published information.

31. **Furnish:** Means to supply and deliver an item to the project site in an operable condition, ready for unpacking, assembly, and installation.
32. **Heavy Timber:** Means sawn timber measuring 5 or more inches in nominal thickness at the least dimension.
33. **Include:** Means inclusion without limitation, in the largest encompassing sense. Other terms, including “such as”, and similar terms, have the same meaning as “include”.
34. **Indicate:** Means expressed by graphic representations or in written form on the Contract Drawings, or elsewhere in the specifications, without limitation of location, unless specifically noted. Other terms, including “indicated”, “shown”, “noted”, “scheduled”, and similar terms, have the same meaning as “indicated”.
35. **In situ:** Means in the position an item will finally occupy.
36. **Install:** Means to handle, unload, store, unpack, assemble, erect, construct, place, anchor, apply, connect, work to dimension, complete, finish, cure, adjust, clean, protect and similar operations at the project site, in final position, and in operable and useable condition.
37. **Installer:** Means the Contractor or other entity engaged by the Contractor as an employee, subcontractor, or sub-subcontractor to perform a particular construction operation at the project site, including preparation, erection, installation, application, construction, re-installation and similar operations required for execution of the work.
38. **Instructions:** Means written directions, diagrams, recommendations, precautions, specifications and similar instructions published by a product supplier, manufacturer or fabricator.
39. **Interior:** Means conditioned space or pertaining to conditioned space that is completely enclosed by floor, wall, and ceiling or roof construction, and solid doors or fenestration systems. Ventilated unconditioned spaces are not interior spaces.
 - a. **Semi-Exterior:** Means an unconditioned or semi-heated space, or pertaining to unconditioned or semi-heated space, that is completely enclosed by floor, wall, and ceiling or roof construction, and solid doors or fenestration systems through which thermal energy may be transferred to or from interior spaces, other semi-exterior spaces, or the exterior. Ventilated unconditioned spaces are not semi-exterior spaces.
 - b. **Exterior:** Means a space that does not meet the definition above for either an “interior” or a “semi-exterior” space.
40. **LEED:** Means U.S. Green Building Council (USGBC) Leadership in Energy & Environmental Design rating system.
41. **Lightgage Metal Framing:** Means non-structural metal framing members having a base metal thickness of 30 mils (20-gage) or less than , and installed in non-load-bearing interior construction assemblies supporting plaster or gypsum board.
42. **Manufacture:** Means to produce standard, custom or proprietary units generally utilizing a mass-production method. Other terms, including “manufactured”, “manufacturer”, and similar terms, have the same meaning as “manufacture”.

43. **Match:** Means provide a portion of the work using the same product, system or execution method identical in dimension, finish, color, texture, and work results to one of the following, as determined by the Architect.
 - a. Another portion of the work.
 - b. Existing conditions adjacent to new work.
 - c. A design reference sample in the Owner's or the Architect's possession.
 - d. An approved sample, range of samples, mockup or sample panel.
44. **Material:** Means a basic substance, often a commodity, used in construction or to manufacturer products and other items used in construction
45. **May:** Means "has discretion to", "is permitted to", or "is authorized to". See definitions below for "must" and "shall".
46. **Must:** Means "is required to" when used to impose an obligation on someone or something other than the object of a sentence; or when the active subject is incapable of assuming a duty or obligation. See definition above for "may" and definition below for "shall".
47. **Non-Roof Surface:** Means the top cover of a building having a slope more than 60 degrees from the zero-degree horizontal plane.
48. **Or Equal:** See definition above for "approved substitute".
49. **Partially-Controlled Enclosure:** See definition above for "enclosure".
50. **Permanent Enclosure:** See definition above for "enclosure".
51. **Permanent Deformation:** Means displacement or change in dimension of a material or component after an applied load has been removed and the specimen has relaxed for specified period of time.
52. **Practical:** Means useful, based on previous experience.
53. **Practicable:** Means useable for a specific purpose; capable of being done with means at hand and circumstances as they are.
54. **Product:** Means components, or assemblies of components, purchased for permanent incorporation into the work, whether purchased specifically for the project or taken from previously purchased stock that was not previously incorporated into another project or facility. Other terms including "manufactured units", "equipment", "accessories", and similar terms, have the same meaning as "products".
55. **Provide:** Means to furnish and install, complete and in-place, ready for operation and use. Whenever the terms "furnish", "install" or "provide" are not explicitly stated, the term "provide" is implied.
56. **Regulation:** Means a law, ordinance, statute, or lawful order issued by authorities having jurisdiction, and rules, conventions, or agreements within the construction industry that prescribe performance of the work.
57. **Related Trades:** Means those installers, applicators, erectors, constructors and fabricators whose work will come into contact with, will penetrate, is directly adjacent to, or is otherwise integral to or materially impacted by the work of a given scope.
58. **Roof Surface:** Means the top cover of a building having a slope of 60 degrees or less from the zero-degree horizontal plane.

59. **Samples:**

- a. **Design Reference Sample:** Means samples of appearance (color, texture, sheen and finish), pre-approved by the Architect.
- b. **Sample:** Means samples of appearance (color, texture, sheen and finish), submitted to the Architect for review and approval.
- c. **Field Sample:** Means physical examples illustrating proposed finishes, coatings, or finish such as concrete, brick, or stone, installed or applied in the field for review by the Architect.
- d. **Sample Panel:** Means scaled-down pre-production samples incorporating full-scale details of architectural features, finishes, textures, transitions and repair techniques for review by the Architect.
- e. **Mock-Up:** Means full-size assemblies erected for review of construction, coordination of the work specified in several sections, testing, operation, training of the trades and similar activities, and aesthetic or other for review by the Architect.

60. **Section:** Means a numbered and titled portion of these Specifications.

61. **Selected Products:** Means materials, products, components and accessories selected by the Contractor from among specified materials, products, components and accessories, or from approved substitution requests, for inclusion into the project. Other terms including "selected materials", "selected manufactured units", "selected equipment", "selected components", "selected accessories", "selected mixes", and similar terms, have the same meaning as "selected products".

62. **Service Condition (SC):** Means a benchmark used to measure a product, assembly or system's exposure to weather or abrasion expressed by one of the following.

- a. **Very Severe Exposure (SC-4):** Means exposed to harsh conditions or subject to frequent exposure to moisture, chemicals, cleaners, and saline solutions, plus likely damage by denting, scratching, or abrasive wear.
- b. **Severe Exposure (SC-3):** Service condition SC-3 (Severe exposure): Exposure to condensation, perspiration, infrequent wetting by rain, and cleaners.
- c. **Moderate Exposure (SC-2):** Exposure mostly to dry indoor atmospheres but subject to occasional condensation, wear, or abrasion.
- d. **Mild Exposure (SC-1):** Exposure to indoor atmospheres with rare condensation and subject to minimum wear or abrasion.

63. **Shall:** Means "has a contractual obligation or duty to" when used to convey a contractual obligation imposed on the subject of a sentence. See definitions above for "may" and "must".

64. **Similar:** Means a portion of work that matches the whole or part, as indicated, of another portion of the work, but has a different geometric configuration.

65. **Submit:** Means for the Contractor to prepare and present written or graphic evidence to the Architect for approval, unless otherwise stated.

66. **Substitution:** Means an unspecified product, system or execution method proposed by a Bidder or the Contractor for incorporation into the work.

67. **Suitable:** Means meant or adapted for the purpose indicated or intended by the Contract Documents, as determined by the Architect. Other terms including

“reasonable”, “proper”, “correct”, “necessary”, and similar terms, have the same meaning as “suitable”.

- 68. **Symmetrical:** Means a portion of work that matches either itself or the whole or part of another portion of the work, as indicated, the geometric configuration of which is reflected about a centerline or axis of a surface or a space, or rotated around a point in space.
- 69. **System:** Means a group of many, often diverse parts joined in regular interaction or interdependence, and subject to a common plan or serving a common purpose to form an integral, organic, or organized whole (e.g., a suspended acoustical ceiling system)
- 70. **Timber:** Means the wood of trees cut and prepared for use as building material.
- 71. **Uncontrolled Enclosure:** See definition above for “enclosure”.
- 72. **Underground:** Means a location that does not meet the definition above for “aboveground” or “above grade”.
- 73. **Wall:** Means one of the sides of a room or building connecting a floor and ceiling or foundation and roof, and having a slope less than 30 degrees from the 90-degree vertical plane.
- 74. **Weather Exposed:** See definition below for “exposed”.
- 75. **Wet Work:** Means materials that need moisture or water added as part of application or installation, which subsequently dry are considered to be wet work (e.g., concrete, plaster, drywall mud, paints and coatings, sealants, etc.).
- 76. **Work Result:** Means the results of applying particular skills and techniques to construction materials, products, assemblies and systems.
 - a. A work result may pertain to either several manufactured products (e.g., exterior insulation and finish system) or a single product (e.g., a chalkboard).
 - b. A work result could also involve only labor and equipment (e.g., a trenching).

1.4 REFERENCE STANDARDS

- A. General: Work specified by reference to a standard or specification published by a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must either meet or exceed the minimum standards of quality for materials and workmanship established by the designated standard or specification.
 - 1. Each entity engaged in construction on the project must be familiar with the specified industry standards applicable to that entity’s construction activity.
 - 2. In case of conflict between referenced standards and documents and the Contract Documents, or between referenced documents, the document having the most stringent requirements applies. Submit discrepancies to the Architect for a decision before proceeding with the affected work any requirements that are different but apparently equal, and uncertainties as to which quality level is more stringent, .
 - 3. Where both a standard and a brand name are specified for a product in the project Manual, the proprietary product named must conform to or exceed the requirements of the specified reference standard. The listing of a trade name in a Project Manual

may not be construed as warranting that such product conforms to the respective reference standard.

B. Applicability:

1. The applicable edition of a reference standard or specification is the latest date of issue (a) 30 days before bids are received; (b) when bids are requested; or (c) if there is no bid, then on the effective date of the Agreement, except
 - a. where a specified publication date follows the title of a referenced standard or specification in the body text of the Contract Documents; and
 - b. issues listed in governing building codes and regulations supersede the above requirements.
2. Provisions of any referenced standards or specifications, whether or not specifically incorporated by reference in the Contract Documents, may not change the duties and responsibilities of the Owner, the Architect, or the Contractor, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor to assign to any of them any responsibility, duty or authority for safety precautions or procedures, or to supervise or direct the performance of the work.

PART 2 - PRODUCTS

2.1 COPIES OF STANDARDS

- A. Copies of applicable referenced standards and specification are not bound in the Project Manual.
- B. Where copies of standards are needed for superintendence and quality control of the work, obtain a copy or copies directly from the publication source and maintain copies in an orderly manner at the project site, available to the Contractor's personnel, subcontractors, the Owner, and the Architect during normal business hours.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 43 39 – MOCKUPS AND FIELD SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for quality assurance mockups and field samples specified in certain architectural specification sections located in Divisions 02 to 14; and in Division 32.
2. Additional requirements for design reference samples, field samples, and sample panels applicable to a particular work result are specified within the appropriate specification Section.

B. Related Requirements:

1. Section 01 83 13 for Type B mockup preconstruction testing requirements, and for site testing requirements.

1.2 REFERENCES

A. Definitions:

1. Mockup:
 - a. Means a full-size physical construction used to
 - 1) perform testing;
 - 2) demonstrate aesthetic effects and the quality of materials and workmanship;
 - 3) review construction techniques;
 - 4) coordinate of the work of multiple sections; and
 - 5) train the trades and personnel involved in executing work.
 - b. Approved mockups establish the standard of appearance and performance by which work is evaluated for conformance to the Contract Documents.
2. Type A Mockup: Means an *ex situ* structure or assembly erected by the Contractor (a) before submittal and review of materials and components; and (b) at a location separate from the building (either a remote location at the project site or an off-site location).
 - a. Type A mockups are specified to verify
 - 1) final material and product selection;
 - 2) items are interfacing correctly and provide required clearances; and
 - 3) that quality control requirements are achievable.
 - b. Type A mockups may be subject to field testing to verify specified performance requirements have been achieved.
 - c. Type A mockups are not a part of the completed permanent work.

- d. After completion and final acceptance, Type A mockups are dismantled, removed, and legally disposed of away from the project site or location where they are constructed.
- 3. Type B Mockup: Means an *ex situ* assembly or system erected by the Contractor (a) after all related submittals have been reviewed by the Architect and returned to the Contractor; (b) before bulk purchasing, mass production, or starting execution of the work; and (c) at a laboratory testing facility as a test specimen for the specific purpose of laboratory testing to verify performance characteristics.
 - a. Type B mockups must be of an adequate size and configuration to demonstrate conformance to the specified performance requirements, including air and water infiltration of all parts, corners, and backings.
 - b. After completion and final acceptance, Type B mockups are dismantled, removed, and legally disposed of away from the project site or location where they are constructed.
- 4. Type C Mockup: Means a full-size room prototype erected (a) after all related submittals have been reviewed by the Architect and returned to the Contractor; and (b) before bulk purchasing, mass production, or starting execution of the work (c) either *in situ* as part of the work, after permanent enclosure of the building; or *ex situ* at a remote permanently enclosed location off-site.
 - a. Type C mockups are required by the Contract Documents to
 - 1) verify selections made under sample submittals;
 - 2) demonstrate the aesthetic effects of submitted and reviewed items; and
 - 3) set quality standards for materials and execution.
 - b. Type C mockups serve as the standard of quality during construction
 - c. Type C mockup components are full size, and incorporate the same materials as those used in the actual work, including details and methods of construction.
 - d. When authorized in writing by the Architect, and after being properly identified for future reference, Type C mockups may remain a part of the work after completion and final acceptance of the work. Otherwise, Type C mockups are dismantled, removed, and legally disposed of away from the project site or location where they are constructed after completion and final acceptance of the work.
- 5. Field Sample: Means an *in situ* assembly or system erected, or an item or material installed or applied by the Contractor as part of the work (a) after permanent enclosure of the building; (b) after all related submittals are reviewed by the Architect and returned to the Contractor; and (c) before bulk purchasing, mass production, or starting execution of the work.
 - a. Field samples are the first construction of assemblies that are repeated elsewhere in the work.
 - b. Field samples serve as a standard of quality during construction
 - c. Field samples are required by the Contract Documents to
 - 1) verify selections made under sample submittals;
 - 2) demonstrate the aesthetic effects of submitted and reviewed items; and
 - 3) set quality standards for materials and execution.
 - d. Field samples serve as the standard of quality during construction

- e. Field samples may be subject to field testing to verify that specified performance requirements are achieved.
- f. When authorized in writing by the Architect, and after being properly identified for future reference, Field Samples remain a part of the work after completion and final acceptance. Otherwise, field samples are dismantled, removed, and legally disposed of away from the project site after completion and final acceptance of the work.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Design Requirements: Engineer, fabricate, and construct mockups and field samples in conformance with
 - 1. the specified standards, performance requirements, material selections,
 - 2. the requirements this section, and
 - 3. the particular work results specified within the appropriate specification Section.
- B. Scheduling: Allow for mockup testing, review, and re-review in the project schedule.
 - 1. Allow at least 10 business days in the Contractor's construction schedule for the Owner's review of each mock up.
 - 2. Time extensions for rejected mockups and multiple re-reviews are not permitted.

1.4 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for the mockup structure and assembly for information before erecting mockups for performance testing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Particular mockup requirements, along with materials, components, and accessories applicable to a particular work result are specified within the appropriate specification Section.
- B. Items incorporated into mockups and field samples must be identical to those specified and, where applicable, to those approved.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Construct mockups and field samples as indicated on the Drawings, including all components, materials, finishes, and fabrication methods, including all supports, attachments, and other accessories.

- B. Construct mock-ups at a location acceptable to the Owner, the Architect, and the testing laboratory, where applicable.

3.2 FIELD QUALITY CONTROL

- A. Testing:

- 1. Laboratory testing is performed on Type B mockups.
 - 2. When indicated, field testing may be performed on Type A mockups and Field Samples.

- B. Review and Approval:

- 1. Unless the Architect specifically approves deviations in writing as a properly executed Change Order, Construction Change Directive, or Architect's Supplemental Instructions conforming to the requirements of Section 01 26 00, approval of any mockup, or any portion thereof, does not constitute an approval of any deviation from the Contract Documents present in any approved item.
 - 2. Where changes in the work are necessary as result of experience gained through the construction of a mockup, those changes must be coordinated with other work, and the affected submittals revised and resubmitted to the Architect for review.
 - 3. If a mockup is rejected, then remove and replace it as many times as necessary to demonstrate conformance to the Contract Documents.
 - 4. The Architect reviews and re-reviews each mockup not more than 2 times. The costs to both the Owner and the Architect costs for subsequent reviews are deducted from progress payments made to the Contractor.

3.3 SCHEDULES

- A. Type A Mockup Schedule:
- B. Type B Mockup Schedule:
- C. Type C Mockup Schedule:
- D. Field Sample Schedule:

END OF SECTION

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

- A. Use water and electric power from Owner's existing system without metering and without payment of use charges.
- B. Contractor to provide a trailer to house own staff including an office space for each of the following: Owner, Construction Manager, and Inspector for the duration of the project.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained heaters with thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 3 - EXECUTION

3.1 TEMPORARY UTILITIES

- A. General: Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
- C. Heating and Cooling: Provide temporary heating and cooling required for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- D. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.2 TEMPORARY SUPPORT FACILITIES

- A. Owner will provide space as necessary for construction operations within the project site.

- B. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Collect waste daily and, when containers are full, legally dispose of waste off-site. Comply with requirements of authorities having jurisdiction.
- C. Install project identification and other signs in locations approved by Owner to inform the public and persons seeking entrance to Project.
- D. Provide a Project Sign Board (8 feet by 4 feet) with post secured to the ground including the graphics. City to provide graphics and language.

3.3 TEMPORARY SECURITY AND PROTECTION FACILITIES

- A. Provide temporary environmental 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.
- B. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
- C. Provide temporary enclosures for protection of construction and workers from inclement weather and for containment of heat.
- D. Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- E. Furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates. Provide blue privacy scrim on fence.
- F. Install and maintain temporary fire-protection facilities, including access road. Comply with NFPA 241.
- G. Provide security to the site for the duration of the project.

3.4 TERMINATION AND REMOVAL

- A. Temporary Utilities: At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
- B. Remove temporary facilities and controls no later than Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

END OF SECTION

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Tree protection of existing trees and plants
- B. Tree pruning of existing trees

1.2 RELATED REQUIREMENTS

- A. Division 01 Section - Temporary Facilities and Controls
- B. Division 31 Section - Site Clearing
- C. Division 32 Section - Landscape Work

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches (150 mm) above the ground for trees up to, and including, 4-inch (100-mm) size; and 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
 - 1. Organic Mulch: 1-pint (0.5-L) 1-quart (1-L) volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- C. 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.
- D. Qualification Data: For qualified arborist and tree service firm.
- E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- G. 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 videotape.
 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

- A. Arborist Qualifications:
1. Certified Arborist as certified by ISA.
 2. Licensed Arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Contractor responsibilities
 - e. Field quality control.

1.6 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or trenching or digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
8. Do not direct vehicle or equipment exhaust toward protection zones.
9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch (25 mm) Insert dimension in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches (100 mm) deep or more; do not obtain from bogs or marshes.
 2. Refer to Section 32 Landscape Work for material requirements.
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 1. Type: Wood and bark chips.
 2. Size Range: 1-1/2" inch minimum, 3" maximum.
 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.
 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts; with 1-5/8-inch- (42-mm-) OD top rails and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 6 feet (1.8 m).
 - b. Galvanized
 - c. Polymer-Coating Color: Black.
 2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches (914 mm) .

- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size: as required
 2. Text: "TREE PROTECTION ZONE - KEEP OUT. No unauthorized entry. No storage of vehicles, materials, or debris. No dumping of chemicals, slurry, paint, oil, etc. "
 3. Lettering: 3-inch (75-mm-)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. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag - Tie a 1-inch (25-mm) blue-vinyl tape around each tree trunk at 54 inches (1372 mm) 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.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
1. Apply 3-inch (76-mm) average thickness of organic mulch. Do not place mulch within 6 inches (152 mm) of tree trunks.

3.3 TREE- AND PLANT-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 and animals from easily entering protected area 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. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.

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 35 feet (10.5 m) on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. 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.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."
- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only roots smaller than 2" in diameter that interfere with installation of utilities. Cut roots as required for root pruning.
- 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 (75 mm) 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.

3.5 ROOT PRUNING

- A. Do Not prune any roots without written authorization from Arborist or Client.
- B. Prune 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.
 - 2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues as approved by the arborist.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Division 31 Section "Grading"
- C. Root Pruning at Edge of Protection Zone: Prune roots 12 inches (300 mm) outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- D. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Do not prune any branches without written authorization from Arborist or Client.
- B. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
 - a. Type of Pruning: Cleaning Thinning Raising Reduction.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
- C. Chip removed branches and dispose of off-site.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. 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.
- D. Minor Fill within Protection Zone: Where existing grade is 4 inches (50 mm) or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 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.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
 1. Submit details of proposed root cutting and tree and shrub repairs.
 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 4. Perform repairs within 24 hours.
 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches (100 mm) or smaller in caliper size.
 2. Provide one new tree(s) of 6-inch (150-mm) caliper size for each tree being replaced that measure more than 4 inches (100 mm) in caliper size.
 - a. Species: Species selected by Architect.
 3. Plant and maintain new trees as specified in Division 32 Section "Landscape Work"
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) O.C. Backfill holes with an equal mix of native soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 015639

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. The term “product” includes the terms “material,” “equipment,” “system,” and terms of similar intent.
- B. Product Substitutions: Substitutions include changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor after award of the Contract.
 - 1. Submit 3 copies of each request for product substitution.
 - 2. Submit requests within 30 days after the Notice to Proceed.
 - 3. Do not submit unapproved substitutions on Shop Drawings or other submittals.
 - 4. Identify product to be replaced and show compliance with requirements for substitutions. Include a detailed comparison of significant qualities of proposed substitution with those of the Work specified, a list of changes needed to other parts of the Work required to accommodate proposed substitution, and any proposed changes in the Contract Sum or the Contract Time should the substitution be accepted.
 - 5. Architect will review the proposed substitution and notify Contractor of its acceptance or rejection.
- C. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. 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. Deliver products to Project site in manufacturer's original sealed container or packaging, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 3. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 4. Store materials in a manner that will not endanger Project structure.
 - 5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
- D. 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.

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

- A. Provide products that comply with the Contract Documents, are undamaged, and are new at the time of installation.
 - 1. Provide products complete with accessories, trim, finish, and other devices and components needed for a complete installation and the intended use and effect.
 - 2. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures:
 - 1. Where Specifications name a single product or manufacturer, provide the item indicated that complies with requirements.
 - 2. Where Specifications include a list of names of products or manufacturers, provide one of the items indicated that complies with requirements.
 - 3. Where Specifications include a list of names of products or manufacturers, accompanied by the term "available products" or "available manufacturers," provide one of the named items that complies with requirements. Comply with provisions for "comparable product requests" for consideration of an unnamed product.
 - 4. Where Specifications name a product as the "basis-of-design" and include a list of manufacturers, provide the named product. Comply with provisions for "comparable product requests" for consideration of an unnamed product by the other named manufacturers.
 - 5. Where Specifications name a single product as the "basis-of-design" and no other manufacturers are named, provide the named product. Comply with provisions for "comparable product requests" for consideration of an unnamed product by another manufacturer.
- C. Unless otherwise indicated, Architect will select color, pattern, and texture of each product from manufacturer's full range of options that includes both standard and premium items.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 70 00 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 CLOSEOUT SUBMITTALS

- A. Record Drawings: Maintain a set of prints of the Contract Drawings as Record Drawings. Mark to show actual installation where installation varies from that shown originally.
 - 1. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
Provide Digital and hard copies of the "PROJECT RECORD DRAWINGS"
- B. Operation and Maintenance Data: Submit 2 hard copies and 1 electronic copy of manual. Organize data into three-ring binders with identification on front and spine of each binder, and envelopes for folded drawings. Include the following:
 - 1. Manufacturer's operation and maintenance documentation.
 - 2. Maintenance and service schedules.
 - 3. Maintenance service contracts.
 - 4. Emergency instructions.
 - 5. Spare parts list.
 - 6. Wiring diagrams.
 - 7. Copies of warranties.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Examine substrates and conditions for compliance with manufacturer's written requirements including, but not limited to, surfaces that are sound, level, plumb, smooth, clean, and free of deleterious substances; substrates within installation tolerances; and application conditions within environmental limits. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to property survey and existing benchmarks.
- C. Take field measurements as required to fit the Work properly. Where fabricated products are to be fitted to other construction, verify dimensions by field measurement before fabrication and, when possible, allow for fitting and trimming during installation.

3.2 CUTTING AND PATCHING

- A. Do not cut structural members or operational elements without prior written approval of Architect.
- B. Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- C. Patch with durable seams that are as invisible as possible. Provide materials to match existing construction or, when applicable, comply with installation requirements specified in other Sections, whichever requirements are more stringent.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for installation. Anchor each product securely in place, accurately located and aligned with other portions of the Work. Clean exposed surfaces and protect from damage.
- B. Clean Project site and work areas daily, including common areas.

3.4 FINAL CLEANING

- A. Complete the following cleaning operations, including a rough and a final clean, before requesting inspection for certification of Substantial Completion:
 - 1. Remove labels that are not permanent.
 - 2. Clean transparent materials, including mirrors. Remove excess glazing compounds. Replace chipped or broken glass.
 - 3. Clean exposed finishes to a dust-free condition, free of stains, films, and foreign substances. Sweep concrete floors broom clean.
 - 4. Vacuum carpeted surfaces and wax resilient flooring.
 - 5. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication. Clean plumbing fixtures. Clean light fixtures, lamps, globes, and reflectors.
 - 6. Clean Project site, yard, and grounds, in areas disturbed by construction activities. Sweep paved areas; remove stains, spills, and foreign deposits. Rake grounds to a smooth, even-textured surface.

3.5 CLOSEOUT PROCEDURES

- A. Substantial Completion: Before requesting Substantial Completion inspection, complete the following:
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit executed copies of warranties, maintenance service agreements, and similar documents. Collated and compiled into a notebook.

4. 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.
 5. Submit Record Drawings and Specifications, operation and maintenance manuals, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items.
 7. Make final changeover of permanent locks and deliver keys to Owner.
 8. Complete startup testing of systems.
 9. Remove temporary facilities and controls.
 10. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 11. Complete final cleaning requirements, including touchup painting.
 12. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.
- C. Request inspection for Final Completion, once the following are complete:
1. Submit a copy of Substantial Completion inspection list stating that each item has been completed or otherwise resolved for acceptance.
 2. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- D. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- E. Submit a written request for final inspection for acceptance. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements. Architect will prepare final Certificate for Payment after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.
- 3.6 DEMONSTRATION AND TRAINING
- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Include a detailed review of the following:
- B. Include instruction for basis of system design and operational requirements, review of documentation, emergency procedures, operations, adjustments, troubleshooting, maintenance, and repairs.

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END OF SECTION

SECTION 01 74 19 – CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes construction waste management procedures.
 - 1. CalGreen: Construction waste management procedures, requirements, and documentation about the 2022 California Green Building Standards Code.
 - a. A copy of the 2022 California Green Building Standards Code is available on the Internet for download (by chapter) at:
https://codes.iccsafe.org/content/CGBC2022P1/Chapter-5-nonresidential-mandatory-measures#CGBC2022P1_Ch05_SubCh5.5.
 - 2. LEED v4 BD+C Construction and Waste Management Planning prerequisite and Construction and Waste Management credit for 2-point threshold.
 - a. A copy of the LEED v4 BD+C reference guide is available on the Internet for download at: <https://www.usgbc.org/resources/leed-v4-building-design-and-construction-current-version>
- B. Contractor shall develop procedures to divert construction and demolition waste generated by the Work to non-landfill receiving sites.
- C. Related Requirements:
 - 1. Section 015200 - Construction Facilities
 - 2. Section 018113.14 - Sustainable Design Requirements
 - 3. Section 311000 - Site Clearing

1.2 REGULATORY REQUIREMENTS

- A. Waste Management: Comply with CalGreen 5.408.1 - Construction Waste Management. Establish a construction waste management plan for the diverted material.
 - 1. Recycle or salvage for reuse a minimum of 75 percent of the non-hazardous construction and demolition waste by CalGreen 5.408.1.3 - Waste Stream Reduction Alternative.
 - a. Include carpet, wood, aggregate, paint, shingles, wallboard, and other materials that have recyclable value.
- B. Reuse and recycle 100 percent of trees, stumps, rocks, and associated vegetation and soils resulting primarily from land clearing by CalGreen 5.408.3 - Excavated Soil and Land Clearing Debris.

- C. Submit documentation to the enforcing agency that demonstrates compliance with CalGreen 5.408.1.4 - Documentation. Sample compliance forms are available in the CalGreen Guide.

1.3 WASTE MANAGEMENT PLAN

- A. Develop and submit a waste management work plan within 30 days of the award of the contract.
 - 1. Outline at least five materials targeted for diversion. Alternative daily cover should be included in total construction waste but excluded from diverted waste calculations for LEED.
 - 2. List each type of waste and whether it will be salvaged, recycled, or disposed of in a landfill. If on-site diversion strategies are not available, explain why.
 - 3. Specify if each material is intended to be a single material waste stream or part of a commingled waste stream.
 - 4. Include points of waste generation, the anticipated percentage of total waste that each material represents (by weight or volume), and site diversion strategies including handling and transportation procedures.
 - 5. For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 6. Provide a list of local waste receivers and processors and the type of recycled or salvaged materials each will accept.
 - 7. Include methods that will be used for separating recyclable waste including sizes of containers, container labeling, and designated locations on the Project site where materials separation will be located.
 - 8. Include a copy of the Construction and Demolition Waste Calculator (USGBC calculator for LEED or equivalent) that will be used to track diversion throughout construction. The USGBC calculator can be downloaded from:
<https://www.usgbc.org/resources/construction-and-demolition-waste-calculator>
 - 9. Include a description of procedures for educating each trade that enters the job site on the Construction Waste Management Plan, and a list of personnel responsible for monitoring waste management activity.
 - 10. Review LEED BD+C v4 Construction and demolition waste management planning prerequisite requirements to ensure the Waste Management Plan meets documentation requirements.

1.4 REPORTING REQUIREMENTS

A. Reporting Requirements:

1. Refer to 018113 Sustainable Design Requirements for additional Action Plan and Monthly Report reporting requirements.
2. Provide an Action Plan for how the diversion of at least 75% of total construction waste from at least 4 material waste streams is anticipated to be achieved. Indicate which metric (weight or volume) will be used to measure waste consistently for all materials throughout the project. Exclude hazardous waste, land-clearing debris, soil, and landscaping materials from calculations.
3. Commingled waste counts as one waste stream unless itemized by the sorting facility. Itemization must be based on the measurement of each component of waste material. Visual inspection is not an acceptable method of evaluation for documenting a percentage.
4. If commingled waste will be counted as one waste stream, the Contractor will need to provide documentation verifying the diversion rate of the commingled waste. Documentation can be project-specific diversion rates provided by the sorting facility or the average annual recycled rate for the sorting facility if the method is regulated by the local governing authority. This documentation can be included in the last Monthly Report. All other Monthly Reports should include a placeholder page for this information.
5. Include the latest status of Construction Waste Management calculations in Monthly Reports
6. Provide information on all recycling or other waste diversion facilities and organizations to be contracted for the project in Action Plan or Monthly Reports.
7. Retain hauler reports and receipts for LEED documentation.
8. Review LEED BD+C v4 Construction and demolition waste management credit option 1 guidance and requirements for diversion to ensure reporting will meet the documentation requirements and credit points will be awarded.
9. Post-construction, upload all LEED waste management-related documentation to LEED Online.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 018113.14 - SUSTAINABLE DESIGN 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 general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain **a LEED Gold certification based on USGBC's "LEED v4 BD+C for New Construction."**
 - 1. Specific requirements for LEED are included in greater detail in other Sections, relative to each product or assembly.
 - 2. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements.
 - 3. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 4. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 5. A copy of the LEED checklist produced to date is attached at the end of this Section for information only.
 - a. The LEED checklist will act as a guide to direct the pursuit of the LEED Gold Certification for the Project.
 - b. USGBC allows projects to substitute LEED v4.1 prerequisite and credit criteria at Owner and Architect discretion. Prerequisite and credits pursuing points under the v4.1 criteria are indicated on the LEED checklist and associated criteria are outlined in this Section and other Sections.
 - c. Construction credits can be changed from v4 to v4.1 or vice versa upon review by the Contractor and discussion with the Owner and Architect.
 - 6. Certification Timeline: The Project will submit the LEED certification applications as a Split Review. The design review applications will be submitted to LEED Online which will occur before or during construction. The construction

review applications on LEED Online will occur after final completion of the project.

- a. The Contractor shall assist in developing the Project's applications by submitting required documentation as indicated in this section and the individual Division 01 through 33 Sections to LEED Online.

B. Related Sections:

1. Section 012500 - Substitution Procedures
2. Section 013000 – Administrative Requirements
3. Section 014000 – Quality Requirements
4. Section 016000 – Product Requirements
5. Section 017419 – Construction Waste Management
6. Section 017800 – Closeout Submittals
7. Section 019113 – General Commissioning Requirements
8. Divisions 03 through 33 Sections for LEED requirements specific to the work of each of these sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

- A. Bio-Based Materials: Products containing some percentage of biologically renewable resources.
- B. BUG Rating: Classification system for luminaires defined in terms of backlight (B), uplight (U), and glare (G).
- C. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that the manufacturer is certified for chain of custody by an FSC-accredited certification body.
- D. Cradle to Cradle: Product certification assessing material health, material reutilization, renewable energy and carbon management, water stewardship, and social fairness.
- E. Declare: A product transparency disclosure that identifies material source, composition, and end-of-life procedures.
- F. EA: LEED Energy and Atmosphere Credit.
- G. Environmental Product Declaration (EPD): A transparency reporting tool communicating what a product is made of and the environmental impact.
- H. EQ: LEED Indoor Environmental Quality Credit.
- I. Extended Producer Responsibility: A waste management strategy promoting integration of life-cycle costs associated with goods into the market price of products.

Typically, this involves a take-back or recycling program run by manufacturer at the end of the product's lifespan.

- J. FSC Certified Content: Wood content that has been harvested in accordance with the "FSC Principles and Criteria" for well-managed forests developed by the Forest Stewardship Council (FSC).
- K. Health Product Declaration (HPD): Disclosure of products contents and associated health information.
- L. LEED Credit Library: Online resource for credit criteria: <https://www.usgbc.org/credits>
- M. LEED: Leadership in Energy & Environmental Design. The U.S. Green Building Council (USGBC) developed the LEED Green Building Rating System as measurement system which evaluates environmental performance from whole building perspective over building's life cycle, providing definitive standard for what constitutes "green building." LEED is a performance-oriented system where credits are earned for satisfying each criterion. Different levels of green building certification are awarded based on the total credits earned.
- N. LEED Online: Website interface for submitting credit documentation requirements as certification applications to GBCI for review.
- O. LEED v4 New Construction (NC) Reference Guide: Definitions that are part of this document apply to this Section. ¹
- P. Life-Cycle Assessment: Evaluation of environmental impacts of a product from cradle to gate, defined by ISO 14040 and ISO 14044. Life-Cycle Inventory: Database that defines environmental input and output for each step in a material or assembly's life cycle.
- Q. Living Product Challenge: A product framework for manufacturers examining place, water, energy, health, materials, and equity in production of materials.
- R. Manufacturer Inventory: A published, complete content inventory for products.
- S. MR: LEED Material and Resources Credit.
- T. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
 - 1. "Postconsumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
 - 2. "Preconsumer" material is defined as material diverted from the waste stream during the manufacturing process, determined as the percentage of material by weight. Reutilization of materials (such as rework, regrind, or scrap generated in

a process and capable of being reclaimed within the same process that generated it per ISO 14021) is excluded.

- U. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- V. Salvaged and reused materials: Materials (from another building) that have been salvaged, refurbished, or reused and are more than one year old at time of use.
- W. Solar Reflectance (SR): The fraction of solar energy that is reflected by a surface on a scale of 0 to 1. Black paint has a solar reflectance of 0; white paint (titanium dioxide) has a solar reflectance of 1. The standard technique for its determination uses spectrophotometric measurements, with an integrating sphere to determine the reflectance at each wavelength.
- X. Solar Reflectance Index (SRI): The measure of a constructed surface's ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. SRI values range from zero (solid black surface) to 100 (solid white surface). SRI value of a material is calculated according to ASTM E1980 and based on the aged, tested values of solar reflectance and thermal emittance.¹
- Y. SS: LEED Sustainable Sites Credit.
- Z. WE: LEED Water Efficiency Credit.
- AA. Vertical Illuminance: Illuminance levels calculated at a point on a vertical service or plane.

1.4 REGULATORY REQUIREMENTS

- A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation or suggestion occurs in the referenced standards, such recommendation or suggestion shall be considered mandatory. In the event of conflict between reference standards, this specification or within themselves, the more stringent standard or requirement shall govern.
 - 1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).
 - 2. California Air Resource Board (CARB)
 - 3. California Department of Public Health (CDPH)
 - 4. Carpet and Rug Institute (CRI).
 - 5. Environmental Protection Agency (EPA).
 - 6. Forest Stewardship Council (FSC).
 - 7. Green Seal (GS).
 - 8. Illuminating Engineering Society of North America (IESNA).

9. Sheet Metal and Air Conditional National Contractor Association (SMACNA).
 10. South Coast Air Quality Management District (SQAMD).
 11. San Diego Air Pollution Control District (APCD).
 12. United States Green Building Council (USGBC): Leadership in Energy and Environmental Design (LEED) Green Building Rating System.
- B. California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
- C. California Air Resource Board (CARB) Airborne Toxic Control Measure (ATCM).
- D. California Department of Public Health Standard Method v1.2-2017.
- E. Green Seal Standard for Commercial Adhesives GS-36, 2013.
- F. "Green Seal Standard for Architectural Coatings" (GS-11), plus "Green Seal Standard for Anti-Corrosive Paints" (GC-03).
- G. Rule 1113- "Architectural Coatings", amended February 5, 2016, effective January 1, 2019: South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.
- H. Rule 1168 - "Adhesive and Sealant Applications", effective date of July 1, 2005, and Rule Amendment date of October 6, 2017; South Coast Air Quality Management District (SCAQMD), State of California, www.aqmd.gov.
- I. Ultra-low emitting formaldehyde (ULEF), EPA Toxic Substances Control Act, Formaldehyde Emission Standards for Composite Wood Products (EPA TSCA Title VI).
- J. SMACNA "IAQ guidelines for Occupied Buildings Under Construction", 2nd Edition 2007, ANSI/SMACNA 008-2008 Chapter 3: The Steel Metal and Air Conditioner National Contractors Association., <http://www.smacna.org>.
- K. ANSI/ASHRAE 52.2-2017, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size", www.ashrae.org.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Contractor's LEED Coordinator: Designate a coordinator that is LEED accredited by the USGBC and has worked on at least one LEED Gold Certified project from Notice to Proceed through Substantial Completion and award of the LEED Certification. Contractor's LEED Coordinator shall oversee the review and coordination of LEED Submittals and LEED Documentation, and work with the LEED Representative to facilitate all LEED Meetings. The LEED Coordinator may also serve as the waste management coordinator.

1. Submit LEED Coordinator qualifications as a LEED Submittal for Architect to review.
- B. Contractor's LEED Representative: Designate a Representative that is LEED Accredited by the USGBC and has worked on at least one LEED Gold Certified project from Notice to Proceed through Substantial Completion and award of the LEED Certification. Contractor's LEED Representative shall oversee the sustainable building for the project, shall conduct or participate in training as required in this Section or other Sections, instruct workers concerning these goals, and shall be present on site when work is in progress. The representative shall work with the LEED Coordinator to facilitate all LEED Meetings.
1. Submit LEED Representative qualifications as a LEED Submittal for Architect to review.
- C. Facilitation of LEED Meetings: Contractor's LEED Coordinator and LEED Representative to schedule and conduct meetings that include representatives as appropriate to the stage of work including the Architect and their consultants, Owner, Owner's Commissioning Authority, Owner's Construction Manager, Contractor and its superintendent, major subcontractors, suppliers, and other concerned parties. All participants shall be familiar with the Project and authorized to conclude matters relating to the Work.
1. Within 30 days prior to commencement of the work, facilitate a LEED Construction Kick-off Meeting to review sustainable design and environmental performance goals for the project, LEED Prerequisites and Credits, LEED Action Plans, and processes for LEED Submittals.
 2. Beginning 30 days after the LEED Construction Kick-off meeting, conduct Monthly LEED Progress Meetings to review the status of the LEED Action Plans and progress on LEED Submittals.
 3. Within 30 days of Substantial Completion, facilitate a LEED Construction Close-out Meeting to review the status of all Construction Credit tracking and create a timeline for the completion of all LEED Documentation and the Preliminary Construction Review Submission.
 4. Schedule or participate in any other intermediate meetings as needed to ensure the project will be awarded all design and construction credits being pursued.
- D. LEED Submittals are in addition to other submittals. If the submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as separate submittals to verify compliance with indicated LEED requirements. Include "LEED" as a suffix in the title of the transmittal and all associated files, file names, reports, correspondence, or related materials.
1. All information pertinent to the LEED requirement shall be highlighted.
 2. All materials product data LEED Submittals must be accompanied by a completed LEED Product Data Submittal Cover Sheet; a sample form is attached at the end of this section.

- E. Action Plans: Provide preliminary Action Plans within 30 days of the date established for commencement of the Work indicating how the following requirements will be met. Include templates or examples of tools that will be used to track the requirements throughout Construction. Include all Construction Credit points identified by the LEED Checklist as "Y" and "?". Work with the Architect to determine the feasibility of each point categorized as "?".
1. Prerequisite SSp1: Erosion and Sedimentation Control Plan. Indicate what ESC for site work measures are anticipated and how they will be documented.
 2. Prerequisite MRp2 and Credit MRc5: Waste management plan complying with Section 017419 "Construction Waste Management".
 3. Credits MRc2, MRc3, MRc4: List of proposed Regional Materials. Plan to identify the extraction, manufacturing, and purchasing location of each material in addition to other requirements of each credit indicated.
 4. Credit MRc2 Option 1: List of proposed materials with life-cycle assessments or Environmental Product Declarations and their valuation as required to contribute to MRc2 Option 1 per the USGBC v4.1 online Credit Library or most recently published Reference Guide.
 5. Credit MRc2 Option 2: List of proposed materials with Embodied Carbon/LCA Action Plans or Reductions in Embodied Carbon and their valuation as required to contribute to MRc2 Option 2 per the USGBC v4.1 online Credit Library or most recently published Reference Guide.
 6. Credit MRc3: List of proposed materials from manufacturers that participate in extended producer responsibility programs, list of proposed bio-based materials, list of proposed wood products certified by the FSC, list of proposed reused materials, and list of proposed materials with recycled content as required to contribute to MRc3 per the USGBC v4.1 online Credit Library or most recently published Reference Guide. Plan to indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
 7. Credit MRc4 Option 1: List of proposed materials with Material Ingredient Reports that demonstrate the chemical inventory of the products to at least 1000 ppm, the type of report and valuation per the USGBC v4.1 online Credit Library or most recently published Reference Guide.
 8. Credit MRc4 Option 2: List of proposed material ingredient optimization or action plans, report type and valuation per the USGBC v4.1 online Credit Library or most recently published Reference Guide.
 9. Credit EQc2: List of proposed materials to contribute to all EQc2 Product Categories per the USGBC v4.1 online Credit Library or most recently published Reference Guide. Plan to indicate which metric, i.e., cost or volume or surface area, each product category will be tracked by
 10. Credit EQc3: Construction indoor air quality management plan.
 11. Credit EQc4: Incorporation of timeline for building flush out per the Indoor Air Quality Assessment credit into the construction schedule.
- F. Monthly Progress Reports: At least 3 business days prior to each Monthly LEED Progress Meeting submit a Monthly Progress Report as a LEED Submittal for Architect review. Monthly Progress Report to have a consistent format and include updated

Action Plans and the latest progress on tracking for each Construction Credit with an Action Plan.

1. Include latest submittal schedule.
 2. Includes latest construction schedule.
 3. Include any updates to total value of permanently installed building products.
 4. Include status on any other LEED related questions that arise.
 5. Include progress on the following spreadsheet calculations as required to be submitted to GBCI with LEED Documentation:
 - a. Construction and Demolition Waste Management
 - b. Building Product Disclosure and Optimization
 - c. Low-Emitting Materials
- G. Complete LEED Documentation required for construction phase credits as outlined by the USGBC LEED v4 or v4.1 BD+C Guide.
1. Submit all documentation as a LEED Submittal for Architect to review prior to uploading to LEED Online. A process and timeline shall be discussed and outlined prior to or during the LEED Construction Close-out Meeting.
- H. Respond to questions and requests from Architect about all LEED prerequisites and credits including those that are Contractor's responsibility to provide, that depend on product selection or product qualities, or that depend on Contractor's procedures, until GBCI has made its determination on Project's LEED certification application.
- I. Submit documentation to GBCI and respond to questions and requests from GBCI about its LEED prerequisites and credits that are Contractor's responsibility, that depend on product selection or product qualities, or that depend on Contractor's procedures, until GBCI has made its determination on Project's LEED certification application.¹
1. Document correspondence with GBCI as informational submittals required for LEED documentation.

1.6 ACTION SUBMITTALS - LEED

- A. General: Provide LEED and sustainable design submittals required in this section and in other Specification Sections as LEED Submittals
- B. LEED Coordinator and LEED Representative Qualifications to include the persons' name, sustainability related experience, and information about what LEED Gold project they have experience on including LEED Project Name and ID.
- C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Cost data to include all taxes, transport, profit, and other expenses to deliver the material to the project site, but exclude labor and equipment required for installation after the material is delivered to the site.

- D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed, indicating how the following requirements will be met:
1. Erosion and Sedimentation Control Plan. Indicate what ESC for site work measures are anticipated and how they will be documented.
 2. List of proposed products sourced (extracted, manufactured, purchased) within 100 miles of the project site.
 3. List of proposed products with EPDs.
 4. List of proposed products complying with requirements for embodied carbon optimization
 5. List of proposed products complying with at least one requirement for sourcing of raw material and estimated total cost of these products.
 6. List of proposed products complying with requirements for material ingredient reporting.
 7. List of proposed products complying with requirements for material ingredient optimization.
 8. Waste management plan complying with Section 017419 "Construction Waste Management"
 9. Construction IAQ management plan.
 10. IAQ Assessment schedule
- E. Monthly Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans.
- F. Design Credit Verification
1. Building Measurement and Verification: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building water consumption and energy-consumption performance over period of time of not less than one year of postconstruction occupancy.
 2. Light Pollution Reduction: documentation for exterior light fixtures indicating BUG ratings, lumens emitted and vertical illuminance values.
 3. Interior Lighting schedule with all CRI and glare ratings identified.
 - a. If substitutions proposed for any interior wall or ceiling finishes, include surface reflectivity values in substitution request.
 4. Indoor Water Use Reduction:
 - a. Product Data and certification for WaterSense-labeled water fixtures.
 - b. Product Data for plumbing fixtures indicating flush or flow rates.
 - c. Product Data for ENERGY STAR water-use appliances.
 - d. Reduced Parking Footprint and Electric Vehicles As-built parking plan with all signage and/or pavement markings identified.
 - e. Photographs of all reserved parking signage and/or pavement marking

5. Electric Vehicles: Product data indicating level 2 charging capacity, SAE J1772 standard compliance, and ENERGY STAR criteria for responding to time-of-use market signals.
 6. Renewable Energy: Photovoltaic system product data and approved shop drawings indicating annual energy production.
 7. Heat Island Reduction:
 - a. Product data indicating SR values for all ground level pavers and paving.
 - b. Product data indicating SRI values for all roofing materials.
 - c. Product data indicating permeability or un-bound percentage of open grid pavement.
 8. Building Life Cycle Impact Reduction: Product data and embodied carbon LCA with environmental impact categories per the LEED v4.1 credit criteria as indicated in this Section or other Sections.
- G. Construction Credit Materials Tracking
1. Building Product Disclosure and Optimization
 - a. All applicable permanently installed building materials product data to be submitted with completed LEED Product Data Submittal Cover Sheet (blank copy attached at end of this Section), sustainability criteria pertinent to all applicable credits highlighted in product data pages, and supplemental documentation demonstrating product contribution to credit requirements such as lab test reports, sustainability standard certification, or other as required by the USGBC online v4.1 Credit Library or most recently published LEED v4 and v4.1 BD+C Guides.
 - b. All LEED Product Data Submittal Cover Sheets to include cost, volume or surface area, and regional distances content filled out as needed for the Contractor to calculate product valuation for each credit contribution.
 - 1) Documentation for regional materials shall indicate location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 2) Supplemental documentation shall not expire prior to procurement date. If documentation expires Contractor team shall inquire with the manufacturer about updated documentation. If the manufacturer intends to update, expired documentation can be included in the LEED Submittal with a note about resubmitting for Record once the up-to-date forms are available.
 - c. Credit MRc2 Option 1: Environmental Product Declarations supplemental documentation should include any of the following per the standards outlined in the USGBC online Credit Library or LEED v4.1 Reference Guide. Environmental Product Declarations must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.

- 1) A publicly available, critically reviewed cradle-to-gate minimum LCA
 - 2) A product-specific internally reviewed Type III EPD
 - 3) An industry-wide third-party certified Type III EPD
 - 4) A product-specific third-party certified Type III EPD
- d. Credit MRc2 Option 2: Embodied Carbon/LCA Action Plans or Reductions in Embodied Carbon supplemental documentation demonstrating one of the following per the standards outlined in the USGBC online Credit Library or LEED v4.1 Reference Guide.
- 1) Embodied Carbon / LCA Action Plan referencing a product-specific Type III EPD or LCA
 - 2) Optimization demonstrated by percent reduction in GWP relative to a baseline shown in a product-specific LCA, product-specific Type III EPD or industry-wide type III EPD.
 - 3) Optimization demonstrated by percent reductions in GWP and two additional impact categories relative to a baseline shown in a product-specific LCA, or product-specific type III EPD.
- e. Credit MRc3: Responsible Sourcing of Raw Materials supplemental documentation should include the following per the standards outlined in the USGBC online Credit Library or LEED v4.1 BD+C Reference Guide.
- 1) Product Data and certification letter from product manufacturers, indicating participation in an extended producer responsibility program.
 - 2) Bio-based materials: ASTM D6866 or ISO 16620-2 equivalent test results or USDA Bio Preferred Voluntary Labeling Initiative certification.
 - 3) Wood products: FSC 100% or FSC Mix label demonstrating FSC certification.
 - 4) Materials reuse: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
 - 5) Recycled content: Product Data and certification letter from product manufacturers, indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content.
- f. Credit MRc4 Option 1 and 2: Material Ingredient reports and action plans or optimizations such as but not limited to the following with all disclosure and optimization criteria per the USGBC v4.1 online Credit Library or LEED v4.1 BD+C Reference Guide highlighted.
- 1) Material Health certificate or C2C v3 or later certificate
 - 2) Declare Label
 - 3) Heath Product Declaration
 - 4) GreenScreen assessment
 - 5) Green Seal certificate
 - 6) Living Product Challenge certificate

- 7) Screening and Optimization plan prepared by the manufacturer and signed by the company executive.
 - 8) Manufacturer inventory meeting optimization and verification criteria
2. Low-Emitting Materials Submittals per the requirements and exclusions indicated in the USGBC v4.1 online Credit Library or LEED v4 and v4.1 BD+C Reference Guides:
 - a. All applicable products to be submitted with completed LEED Product Data Submittal Cover Sheets (blank copy attached at end of this Section), sustainability criteria pertinent to all applicable credits highlighted in product data pages, and supplemental documentation demonstrating product contribution to credit requirements such as lab test reports, sustainability standard certification, or other as required by the USGBC online v4.1 Credit Library or most recently published LEED v4.1 BD+C Guide.
 - b. Documentation for all naturally occurring materials made from inorganic materials that meet inherently non-emitting sources criteria.
 - c. Documentation for all products that are more than one year old at time of use and meet salvaged and reused materials criteria.
 - d. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC emissions evaluation and VOC content evaluations, including laboratory test reports showing compliance with requirements for low-emitting materials.
 - e. Product data for paints and coatings used inside the weatherproofing system, indicating VOC emissions evaluation and VOC content evaluations, including laboratory test reports showing compliance with requirements for low-emitting materials.
 - f. Laboratory test reports for flooring, indicating VOC emissions evaluations or compliance with other requirements for low-emitting materials.
 - g. Laboratory test reports for wall materials, indicating VOC emissions evaluations or compliance with other requirements for low-emitting materials.
 - h. Laboratory test reports for ceilings, indicating compliance with requirements for low-emitting materials.
 - i. Laboratory test reports for insulation, indicating compliance with requirements for low-emitting materials.
 - j. Laboratory test reports indicating formaldehyde emissions evaluation for products containing composite wood or agri-fiber products or wood glues, indicating compliance with requirements for low-emitting materials.

H. Construction Management Plans

1. Construction and Demolition Waste Management Plan
 - a. Documentation complying with Section 017419 "Construction Waste Management and Disposal."

2. Construction Indoor Air Quality Management Plan

- a. Construction IAQ management plan.
- b. Product Data for temporary filtration media.
- c. Product Data for filtration media used during occupancy.
- d. Construction Documentation: Six photographs at three different times during construction period, along with brief description of SMACNA approach employed, documenting implementation of IAQ management measures, including protection of ducts and on-site stored or installed absorptive materials.

G. Commissioning: Documentation complying with Section 019113 General Commissioning Requirements.

H. Indoor Air Quality Assessment:

- a. Signed statement describing the building air flush-out procedures, including dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
- b. Product Data for filtration media used during flush-out and occupancy.
- c. Report from testing and inspecting agency indicating results of IAQ testing and documentation that show compliance with IAQ testing procedures and requirements.

I. LEED Documentation for LEED Online construction applications to include all documentation for construction prerequisites and credits that are the primary responsibility of the Contractor. For documentation that is required in the LEED Online platform, include a PDF copy or screenshot containing all information on the form.

1. Construction Activity Pollution Prevention prerequisite
2. Construction and Demolition Waste Management Planning prerequisite
3. Construction and Demolition Waste Management credit
4. Environmental Product Declaration credit
5. Sourcing of Raw Materials credit
6. Material Ingredients credit
7. Low-Emitting Materials credit
8. Construction Indoor Air Quality Management credit
9. Indoor Air Quality Assessment credit

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Sustainability Consultant and LEED coordinator.

B. Correspondence with GBCI on LEED credits to be submitted to the Architect for information only.

1.8 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.
- B. LEED Representative: Engage an experienced LEED-Accredited Professional to oversee the sustainable building for the project and be present on site when work is in progress.
- C. Contractor's Quality Control Responsibilities: Contractor is solely responsible for quality control of the Work.
- D. Contractor's LEED Coordinator and LEED Representative, as outlined under Administrative Requirements in this Section, shall be consistent throughout the project. If LEED Coordinator or LEED Representative role changes hand, provide new qualifications submittal for Architect Review. Responsibilities shall include at a minimum.
 - 1. Development and maintenance of LEED Action Plans
 - 2. Review of all LEED Submittals to ensure all pertinent information is highlighted, the LEED Product Data Submittal Cover Sheet is complete, and all supplemental documents demonstrating contribution to credits are attached.
 - 3. Review of Monthly Reports.
 - 4. Facilitation of all LEED Meetings.
 - 5. On-site sustainable building oversight.
 - 6. Site walk and photographic documentation for SSp1, MRp2 and MRc5, and EQc3.
 - 7. Coordination with Contractor team on sustainability updates discussed during pre-bid, pre-construction, and regular job site meetings.
 - 8. Coordinate with the Owner's Commissioning Agenda on all testing requirements and EAp1 and EAc1 commissioning credit LEED Documentation.
 - 9. Review all LEED Documentation Submittals, make corrections noted by the Architect, and upload documentation to LEED Online.
 - 10. Correspond with GBCI reviewers and address their comments.
 - 11. Quality Assurance oversight of all other Administrative Requirements noted in this Section.
- E. Additional Administrative Requirements for LEED Meetings for Quality Assurance shall include:
 - 1. At least 3 business days prior to all LEED Meetings provide a meeting Agenda.
 - 2. No more than 3 business days after scheduled LEED Meetings, provide meeting minutes to all invitees.
 - 3. Schedule intermediate meetings as needed to ensure scope, installation, and documentation as needed to achieve credit requirements and points awarded by GBCI.
- F. On-site training shall include:
 - 1. Overview of environmental issues related to the building industry.

2. LEED Building System: Requirements for this project.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated.
- B. Refer to the online LEED Credit Library or LEED v4 or v4.1 NC Reference Guide for valuation criteria for each product and applicable credit.
- C. At least 20 different permanently installed products from at least five different manufacturers shall have life cycle assessments or EPDs that comply with LEED requirements.
- D. Products sourced from at least five different manufacturers must meet at least one of the responsible sourcing and extraction criteria for at least 15% by cost of the total value of permanently installed building products:
 1. Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility.
 2. Bio-based products and materials other than wood must be tested using ASTM Test Method D6866 or equivalent method ISO 16620-2 or be certified to the USDA Bio Preferred Voluntary Labeling Initiative that includes verification via ASTM 6866 testing.
 3. Wood products must be certified by the Forest Stewardship Council or USGBC-approved equivalent.
 4. Materials reuse: Reuse includes salvaged, refurbished, or reused products.
 5. Recycled content as the sum of post-consumer recycled content plus one-half of the pre-consumer recycled content based on weight.
- E. At least 20 different permanently installed products from at least five different manufacturers shall comply with LEED requirements for material ingredient reporting.

2.2 LOW-EMITTING MATERIALS

- A. Low-emitting criteria per the online LEED v4.1 Credit Library or most recently published LEED v4.1 BD+C Reference Guide.
 1. Inherently non-emitting sources
 2. Salvaged and reused materials
 3. VOC emissions evaluation

4. VOC content evaluation
 5. Formaldehyde emissions evaluation
- B. Paints and Coatings: For field applications that are inside the weatherproofing system, 75 percent of paints and coatings meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.
1. VOC emissions evaluation criteria:
 - a. Product has been tested according to California Department of Public Health (CDPH) Standard Method v1.2-2017 and complies with the VOC limits in Table 4-1 of the method. Additionally, the range of total VOCs after 14 days (336 hours) was measured as specified in the CDPH Standard Method v1.2 and is reported (TVOC ranges: 0.5 mg/m³ or less, between 0.5 and 5 mg/m³, or 5 mg/m³ or more).
 - b. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.
 - c. The statement of product compliance must include the exposure scenario(s) used, the range of total VOCs, and must follow the product declaration guidelines in CDPH Standard Method v1.2-2017, Section 8. Manufacturer statements must also include a summary report from the laboratory that is less than three years old, and the amount of wet-applied product applied in mass per surface area. Organizations that certify manufacturers' claims must be accredited under ISO/IEC 17065.
 2. VOC content criteria:
 - a. Product data demonstrating methylene chloride and perchloroethylene has not been intentionally added, statement of product compliance by manufacturer or a USGBC-approved third-party that product meets VOC content limits outlined by one of the following standards. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
 - 1) California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 2) South Coast Air Quality Management District (SCAQMD) Rule 1113, amended February 5, 2016, effective date 1/1/19.
- C. Adhesives and Sealants: For field applications that are inside the weatherproofing system, 75 percent of adhesives and sealants meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.
1. VOC emissions criteria under paragraph 2.2.B.1.
 2. VOC content criteria:
 - a. Product data demonstrating methylene chloride and perchloroethylene has not been intentionally added, statement of product compliance by manufacturer or a USGBC-approved third-party that product meets VOC content limits outlined by SCAQMD Rule 1168, amended October 6, 2017. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.

- D. Flooring: A minimum of 90 percent of flooring products meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria.
1. VOC emissions criteria under paragraph 2.2.B.1.
 2. If product is inherently non-emitting, provide product data demonstrating product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants that include organic chemicals.
 3. Includes hard and soft flooring, wall base, transition strips, stair nosing, floor grills, entryway systems, underpayments, and other floor coverings.
 4. Subflooring to be excluded and included in the composite wood category if applicable.
 5. Products wet-applied on flooring to be excluded and included in the paints and coatings category.
- E. Walls: A minimum of 75 percent of wall panel products meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria.
1. VOC emissions criteria under paragraph 2.2.B.1.
 2. If product is inherently non-emitting, provide product data demonstrating product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants that include organic chemicals.
 3. Includes wall coverings, wall paneling, wall tile, gypsum, curtain walls, trim, interior and exterior doors, non-structural wall framing, interior and exterior windows, window treatments, countertops, laminate or veneer on built-in cabinets, non-structural sandwich panels, and CMU.
 4. Exclude cabinetry and include in composite wood category if applicable.
 5. Exclude vertical structural elements and include them in composite wood category if applicable.
- F. Ceilings: A minimum of 90 percent of ceilings meet the VOC emissions evaluation or inherently non-emitting sources criteria or salvaged and reused materials criteria.
1. VOC emissions criteria under paragraph 2.2.B.1.
 2. If product is inherently non-emitting, provide product data demonstrating product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants that include organic chemicals.
 3. Includes all ceiling panels, tiles, gypsum, plaster, suspended system, and glazed skylights.
 4. Exclude overhead structural elements and include them in composite wood category if applicable.
- G. Insulation: A minimum of 75 percent of insulation products meet the VOC emissions evaluation.
1. VOC emissions criteria under paragraph 2.2.B.1.
 2. Include all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, foam, loose-fill, and blown or sprayed insulation

3. Exclude HVAC duct and plumbing piping insulation unless Contractor suggests including.
- H. Composite Wood: A minimum of 75 percent of all composite wood meets the formaldehyde emissions evaluation or salvaged and reused materials criteria.
1. Formaldehyde emissions evaluation criteria options:
 - a. Certified as ultra-low-emitting formaldehyde (ULEF) product under EPA Toxic Substances Control Act, Formaldehyde Emission Standards for Composite Wood Products (TSCA, Title VI) (EPA TSCA Title VI) or California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM).
 - b. Certified as no added formaldehyde resins (NAF) product under EPA TSCA Title VI or CARB ATCM).
 - c. Wood structural panel manufactured according to PS 1-09 or PS 2-10 (or one of the standards considered by CARB to be equivalent to PS 1 or PS 2) and labeled bond classification Exposure 1 or Exterior.
 - d. Structural wood products manufactured according to ASTM D 5456 (for structural composite lumber), ANSI A190.1 (for glued laminated timber), ASTM D 5055 (for I-joists), ANSI PRG 320 (for cross-laminated timber), or PS 20-15 (for finger-jointed lumber).
 2. Includes particleboard, medium density fiberboard, hardwood plywood with veneer, composite or combination core products, and wood structural panels or structural wood products.
 3. Exclude products covered in flooring, ceiling, wall panels, or furniture categories.

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

- A. Smoking is not permitted within the building or within 25 ft. of entrances, operable windows, or outdoor-air intakes.

3.2 MEASUREMENT AND VERIFICATION

- A. Implement measurement and verification plan consistent with Option D: Calibrated Simulation, Savings Estimation Method 2 in the EVO's "International Performance Measurement and Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction."
- B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.
- C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

- D. Measurement and verification period shall cover at least one year of post-construction occupancy.

3.3 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Section 017419 "Construction Waste Management"

3.4 CONSTRUCTION INDOOR-AIR-QUALITY (IAQ) MANAGEMENT

- A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - 2. Replace all air filters per Division 23 Specification requirements, immediately prior to occupancy.

3.5 INDOOR-AIR-QUALITY (IAQ) ASSESSMENT

- A. Flush-Out:
 - 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
 - a. Comply with Section 01 91 13 - Commissioning Requirements, and Section 01 57 31 - Construction IAQ Management Plan.
 - 2. As directed by the Owner, if occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.
 - a. Comply with Section 01 91 13 - Commissioning Requirements, and Section 01 57 31 - Construction IAQ Management

3.6 EROSION AND SEDIMENTATION CONTROL (ESC)

- A. Comply with requirements for Construction Activity Pollution Prevention as outlined in the Erosion and Sediment Control Plan.

END OF SECTION 018113.14

LEED Product Data Submittal Cover Sheet

INSTRUCTIONS

1. This form must be completed for all permanently installed building materials that require product data submittals, or as determined by the Contractors Materials Action Plan. ¹
2. Subcontractor to attach supporting documentation for each credit criteria as required under Section 01 81 13 and per the LEED BD+C v4 and v4.1 Reference Guides. Verify supporting documentation is still active, i.e. not expired.
3. Contractor to submit complete Cover Sheet and supporting documentation with product data submittal, or as separate submittal simultaneous to product data submittal. In either scenario include "LEED" in the submittal name.
4. All information applicable to LEED credits to be highlighted on supporting documentation.
5. An Excel version of this form includes drop down options for credit columns that note "Select Option".

Specification Section: _____

Subcontractor: _____



				MATERIALS & RESOURCES CATEGORY											INDOOR ENVIRONMENTAL QUALITY CATEGORY							
				Building Product Disclosure and Optimization (BPDO) Credits (LEED v4.1 substitution)											Low-Emitting Materials Credit (LEED v4.1 substitution) ³							
				Regional Material ³	Environmental Product Declaration (EPD) Credit		Material Ingredients Credit			Sourcing of Raw Materials Credit												
				Doubles product value for BPDO credits	Credit Option 1	Credit Option 2	Credit Option 1		Credit Option 2	Credit Based on % of Total Materials Cost ⁷			Credit Based on Volume or Cost									
					Track 20 products for 1pt	Track 5 products for 1pt	Track 20 products for 1pt		Track 5 products for 1pt	Track 30% of Total Material Cost for 2pts			Track 4 Categories for 3pts: Adhesives & Sealants, Paints & Coatings, Flooring, Wall panels, Ceilings, Insulation, Furniture, and Composite Wood									
#	Manufacturer Name	Product Name	Product cost* (\$)	Extracted, Manufactured and Purchased within 100 miles ⁴	EPD is Product Specific (PS) or Industry Wide (IW)	EPD Optimization	Material Ingredient Report	Material Ingredient Report Threshold Level	Is Material Ingredient Report 3rd Party Verified	Material Ingredient Optimization	Extended Producer Responsibility *valued at 50% of cost	Bio-based materials (not wood) *valued at 50% of cost	FSC Certified Products *valued at 100% of cost	Post-consumer recycled content	Pre-consumer recycled content	Inherently Non-Emitting ⁹	Compliance with CDPH v1.2-2017 Emissions Test	VOC Content	VOC Content Limit Per Applicable Standard	Total Product Volume	Wood products: ULEF or NAF	Wood products: CARB exempt
				Y/N	Select Option ⁵	Select Option ⁵	Select Option ⁵	Select Option ⁵	Y/N	Select Option ⁵	Select Option ⁵	Select Option ⁵	Select Option ⁵	(%)	(%)	Y/N	Select Option ⁵	(g/L)	Select Option ⁵	(L)	Y/N	Y/N
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

¹ Special equipment, fire suppression system components, and active components of MEP systems are excluded from the Building Product Disclosure and Optimization credits. Passive components of MEP systems (e.g., pipes, ducts, conduit, insulation, plumbing fixtures, lamp housing) are optional. Furniture is also optional, but if any furniture is included all furniture must be included.

² Product cost includes all expenses to deliver the material to the project site, including taxes, transport, fabrication and profit. Site labor and installation should be excluded.

³ Any products that meet the Regional Material 100 mile requirement are valued at 200% for each BPDO credit tracking metric.

⁴ Distance is defined as straight-line measurement, not specific road or other transit route.

⁵ Refer to online LEED v4 and v4.1 credit library and most recently published LEED v4 and v4.1 Reference Guide for specific documentation, standard, or certification level required to contribute towards this credit. If documentation or certification levels do not meet the requirements for contribution, the data cell should be left blank. If you are unsure if the product meets the requirements, request consult from the General Contractor and Architect.

⁶ Any Material Ingredients credit compliant reports with third-party verification that includes the verification of content inventory are worth 1.5 products for credit achievement calculations.

⁷ The Sourcing of Raw Materials credit will be calculated by the Contractor as a % of total materials cost. The total materials cost must include divisions 03-10, 12 (excluding furniture), 31 60 00, 32 10 00, 32 30 00, and 32 90 00.

⁸ The Low-Emitting Materials credit applies to products inside the weatherproofing. Product categories include Adhesives & Sealants, Paints & Coatings, Flooring, Wall panels, Ceilings, Insulation, Furniture, and Composite Wood. Contractor Materials Action Plan to identify product categories to be tracked to meet the quantity of categories required to achieve points targeted on project LEED checklist. Refer to the online LEED v4.1 credit library for further explanation on which materials must be included or excluded for each product category (e.g. Wall panels must include finish treatments, gypsum, non-structural framing, doors, windows, window treatments, countertops, millwork laminate/veneer, CMU, etc.)

⁹ Inherently nonemitting sources means that a product is an inherently nonemitting source of VOCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood) and has no binders, surface coatings, or sealants that include organic chemicals.

I, _____, an authorized representative of _____ hereby certify that the material information submitted is an accurate representation of the material to be provided under our contract.

Authorized Rep Email: _____

Authorized Rep Direct Phone Number: _____

Authorized Representative Signature _____ Date _____

Moorpark City Library

City of Moorpark High Street
Moorpark CA 93021
LPA Proj No.: 30647
LEED Project: 1000166756



LEED v4 NC BD+C Checklist

In Progress: Bid Submittal

1/27/2025

66	4	40	Project Point Estimates					
Yes	?	No	Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points					
1			IPc1	Integrative Process	d	1	Early-phase energy and water analysis and cross-discipline synergies. Min. 2 energy strategies and all water strategies to be considered (indoor and outdoor preliminary calcs and alternate and process water considerations). Complete USGBC Integrative Process worksheet.	All
6		10	Location and Transportation			16 pts	Comments	Leads
			LTc1	LEED for Neighborhood Development Location	d	16	Not applicable - site does not qualify.	-
1			LTc2	Sensitive Land Protection	d	1	Option 1: The site is located on previously developed land. Description of previous development provided by Civil on LEED Online.	Arch + Civil
		2	LTc3	High Priority Site	d	2	Not applicable - site does not qualify.	-
3		2	LTc4	Surrounding Density & Diverse Uses (v4.1)	d	5	v4.1 substitution, option 3: Walkscore 76 = 3-points. Upload screenshot from Walkscore website to LEED Online.	Arch
		5	LTc5	Access to Quality Transit (v4.1)	d	5	Not applicable - insufficient transit trips for any v4 or v4.1 pt threshold.	-
		1	LTc6	Bicycle Facilities	d	1	Not applicable - no showers in scope.	-
1			LTc7	Reduced Parking Footprint (v4.1)	d	1	v4.1 substitution. No local zoning requirements. Baseline = 101. 30% below baseline = 70. Latest count is 69, point achievable. AH to send precedent	Landscape
1			LTc8	Electric Vehicles (v4.1)	d	1	v4.1 substitution. Electric Vehicle Supply Equipment (EVSE) to serve at least 5% of Parking or 10% EV ready. 8/8 EV ready qty. exceeds this.	Arch
1		9	Sustainable Sites			10 pts	Comments	Leads
Y	SSp1			Construction Activity Pollution Prevention	c	Req	Refer to Erosion and Sediment Control Plan or Storm Water Pollution Prevention Plan.	GC
		1	SSc1	Site Assessment	d	1	Site Assessment Worksheet on how we're addressing climate, topography, hydrology, winds, etc. and site plan highlighting strategies in worksheet also required. Not actively pursued.	-
		2	SSc2	Site Development - Protect or Restore Habitat	d	2	Not feasible due to site scope.	-
		1	SSc3	Open Space	d	1	Not feasible due to site scope.	-
		3	SSc4	Rainwater Management	d	3	Not feasible due to site scope.	-
		2	SSc5	Heat Island Reduction	d	2	Not feasible due to site scope.	-
1			SSc6	Light Pollution Reduction	d	1	Option 1. BUG method for LZ3 confirmed, not confirmed for LZ2. Exterior illuminated signage - yes - note about max luminance added to drawings. Will submit with narrative for LZ3 logic.	Lighting

Moorpark City Library

City of Moorpark High Street
Moorpark CA 93021
LPA Proj No.: 30647
LEED Project: 1000166756



LEED v4 NC BD+C Checklist

In Progress: Bid Submittal

1/27/2025

66	4	40	Project Point Estimates			
Yes	?	No	Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points			
6		5	Water Efficiency	11 Pts	Comments	Leads
Y			WEp1 Outdoor Water Use Reduction	d Req	Irrigation water use to be reduced below the baseline by 30% min. for prerequisite - confirmed.	Landscape
Y			WEp2 Indoor Water Use Reduction	d Req	1.1 GPF WC, 0.125 GPF urinals, 0.35 GPM lavs, 1.5 GPM sinks. WaterSense labeled. Process water confirmed N/A. Confirmed no dishwasher, ice machine, or washing machine.	Plumbing
Y			WEp3 Building-Level Water Metering	d Req	Building to include dedicated potable water meter. Owner to sign letter of commitment to share water use data with USGBC for 5-years. Design team to provide draft letter for the City.	Owner
1		1	WEc1 Outdoor Water Use Reduction	d 2	Anticipating 1-point for at least 50% reduction below the baseline. Latest calculation at 62%.	Landscape
4		2	WEc2 Indoor Water Use Reduction	d 6	Plumbing confirmed flush/flow rates recommended and preliminary calc 44% for 4-points. Confirm FTE and average daily visitors counts with owner for final calc. (Will not drop below 40% for 4-points).	Plumbing
		2	WEc3 Cooling Tower Water Use	d 2	Not applicable to scope.	-
1			WEc4 Water Metering	d 1	Project to include separate, dedicated domestic hot water and irrigation water meters. Plumbing confirmed domestic hot water. Landscape confirmed irrigation meter.	Landscape + Plumbing
30		3	Energy & Atmosphere	33 Pts	Comments	Leads
Y			EAp1 Fundamental Commissioning and Verification	c Req	Commissioning for quality assurance. CxA to review OPR, BOD, and CDs, develop Cx plan, develop checklists and procedures, etc. P2S includes all prerequisite requirements. Refer to 01 91 13 General Commissioning Requirements, 01 91 15 Building Enclosure Commissioning and the Commissioning Agent's Cx Plan.	CxA + GC
Y			EAp2 Minimum Energy Performance	d Req	Reduce predicated energy use by 5% below ASHRAE 90.1 baseline for prerequisite. Confirmed.	S+AR + Mech
Y			EAp3 Building-Level Energy Metering	d Req	Dedicated electrical meter confirmed. Owner to sign letter of commitment to share energy use data with USGBC for 5-years. Design team to provide draft letter for the City.	Elec + Owner
Y			EAp4 Fundamental Refrigerant Management	d Req	No CFCs confirmed.	Mech
6			EAc1 Enhanced Commissioning	c 6	MEP and renewable systems Cx, building envelope Cx, and monitoring-based Cx. P2S scope includes all credit requirements. Refer to 01 91 13 General Commissioning Requirements, 01 91 15 Building Enclosure Commissioning and the Commissioning Agent's Cx Plan.	CxA + GC
18			EAc2 Optimize Energy Performance	d 18	50% reduction below ASHRAE 90.1 baseline to maximize points. 50% confirmed for 18 pt but 54% for EP pt not feasible.	S+AR + Mech
		1	EAc3 Advanced Energy Metering	d 1	Must meter whole-building energy supply, renewable energy, and any end use >10% of total annual consumption. Per energy model: equipment/plug loads, interior lights, and space cooling. Not feasible.	-
		2	EAc4 Grid Harmonization (v4.1)	c 2	Project will serve as a Ventura County Cooling Center. All zones critical. Building will not participate in demand response events.	-
5			EAc5 Renewable Energy (v4.1)	d 5	v4.1 substitution. Tier 1 for on-site renewable energy production. Project to include approximately 50% renewable energy. 20% required for maximum of 5-points, 25% for EP point.	Elec + S+AR
1			EAc6 Enhanced Refrigerant Management	d 1	Option 1 not feasible. Refrigerant GWP exceeds 50. Option 2 per LEED Online calculator confirmed.	Mech

Moorpark City Library

City of Moorpark High Street

Moorpark CA 93021

LPA Proj No.: 30647

LEED Project: 1000166756



LEED v4 NC BD+C Checklist

In Progress: Bid Submittal

1/27/2025

66	4	40	Project Point Estimates
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Yes ? No Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points

5	3	5	Materials & Resources	13 Pts	Comments	Leads
Y			MRp1 Storage & Collection of Recyclables	d	Req	Interiors + Landscape
Y			MRp2 Construction & Demolition Waste Management Planning	c	Req	GC
		5	MRc1 Building Life-Cycle Impact Reduction (v4.1)	d	5	-
1	1		MRc2 Building Product Disclosure & Optimization: Environmental Product Declarations (v4.1)	c	2	GC
1	1		MRc3 Building Product Disclosure & Optimization: Sourcing of Raw Materials (v4.1)	c	2	GC
1	1		MRc4 Building Product Disclosure & Optimization: Materials Ingredients (v4.1)	c	2	GC
2			MRc5 Construction & Demolition Waste Management	c	2	GC
10		6	Indoor Environmental Quality	16 Pts	Comments	Leads
Y			EQp1 Minimum IAQ Performance	d	Req	Mech
Y			EQp2 Environmental Tobacco Smoke Control	d	Req	Arch + Owner
2			EQc1 Enhanced Indoor Air Quality Strategies	d	2	Arch + Mech
3			EQc2 Low-Emitting Materials (v4.1)	c	3	GC
1			EQc3 Construction IAQ Management Plan	c	1	GC
1		1	EQc4 Indoor Air Quality Assessment	c	2	GC
1			EQc5 Thermal Comfort	d	1	Mech + Arch + Owner
2			EQc6 Interior Lighting (v4.1)	d	2	Lighting + Interiors
		3	EQc7 Daylight (v4.1)	d	3	-
		1	EQc8 Quality Views (v4.1)	d	1	-
		1	EQc9 Acoustic Performance (v4.1)	d	1	-

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LEED v4 NC BD+C Checklist

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1/27/2025

66	4	40	Project Point Estimates				
Yes	?	No	Certified: 40-49 points Silver: 50-59 points Gold: 60-79 points Platinum: 80+ points				
4	1	1	Innovation	d/c	6 Pts	Comments	Leads
1			INc1.1 Innovation: Purchasing - Lamps	d	1	All LED will achieve this Innovation point.	Lighting
		1	INc1.2 Innovation: Exemplary Performance - Optimize Energy Performance	d	1	54% improvement for exemplary performance not feasible.	-
1			INc1.3 Innovation: Exemplary Performance - Renewable Energy	d	1	25% for exemplary performance confirmed.	Elec + S+AR
	1		INc1.4 Innovation	d	1	Safety First: Design for IAQ and Infection Control pilot closed. Alternative Innovation options can be researched if needed. Consider: Green Building Education.	-
1			INc1.5 Innovation (Pilot Credit): Social equity within the supply chain	d	1	3 products from at least 2 mfr. to meet verified social equity criteria. Interface Modular Tile on CQuestBio backing, Tarkett Thermoset Rubber Wall Base, and Shaw walk-off mat and/or Mosa Tile.	Interiors
1			INc2 LEED Accredited Professional	c	1	Multiple LEED AP BD+C on design team.	S+AR
3		1	Regional Priority (Zip code 93021)		4 Pts	Comments	Leads
1			RPc1.1 Regional Priority: Outdoor Water Use Reduction	d	1	Achieve 1 point.	Landscape
1			RPc1.2 Regional Priority: Indoor Water Use Reduction	d	1	Achieve 3 points	Plumbing
1			RPc1.3 Regional Priority: Renewable Energy	d	1	Achieve 3 points	Elec + S+AR
		1	RPc1.4 Regional Priority: Grid Harmonization (v4.1)	c	1	Not pursued because library will be community cooling center. Rainwater Management and Open space also not feasible.	-

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Commissioning is a designed quality-assurance process for achieving, verifying and documenting that the performance of facilities, systems, and assemblies meet the Owner's documented objectives and criteria. The design team, contractor and subcontractors provide the quality control for the design, the installation and startup of the building systems. The commissioning process provides review and quantitative functional testing in order to provide assurance that the quality control efforts of the designers and contractors are successfully completed.
- B. Commissioning includes the completion of a formal commissioning process on the equipment and systems within the Commissioning Scope of Work, as specified within Section 01 91 15. Commissioning is performed by the Commissioning Team under the leadership of the Commissioning Authority (CA). The entire Commissioning Team is responsible for performing the process and achieving successful commissioning results. Commissioning Team is defined in Definition of Terms portion of this section of the specifications.
- C. Commissioning Standards: The commissioning process shall be in accordance with:
 - 1. All sections of the Contract Documents
 - 2. ASHRAE Guideline 0-2019
 - 3. 2022 California Energy Code
 - 4. 2022 CalGreen
 - 3. AABC Commissioning Group (ACG)
 - 4. Building Commissioning Association (BCxA)
- D. Contractors' Responsibility: The Contractor is responsible for completion of the specified commissioning work. The contractors responsibilities include:
 - 1. The General Contractor shall provide a Commissioning Coordinator (CC), as defined in Definition of Terms portion of this section of the specifications. The General Contractor's Commissioning Coordinator is responsible for managing the specified commissioning work. **General Contractor shall ensure that all sub-contractors including but not necessarily limited to mechanical, electrical, test and air balance, controls, plumbing, and irrigation disciplines are fully familiar with the commissioning requirements and responsibilities stated herein.**
 - 2. The Contractor shall be responsible for providing material, equipment, access, meters and instrumentation, and labor to participate in the specified commissioning process. The Contractor will assure the participation and cooperation of sub-contractors and vendors under their jurisdiction, as required to complete the commissioning process.

3. Contractor shall be responsible for having independent agencies provide electrical systems tests as specified in Division 26 or other applicable sections of the contract documents.
 4. The Contractor will support the commissioning process by integrating it into the construction process and schedule.
 5. Contractor shall coordinate start-up and testing and balancing phases to allow a reasonable time for the commissioning tests to be conducted prior to building occupancy or specified operational date for the project.
 6. Contractor shall demonstrate through functional tests provided by the commissioning authority that systems perform per design.
- E. Support of Materials, Equipment and Systems Suppliers: Suppliers of major equipment and systems within the Commissioning Scope of Work (specified elsewhere in Section 01 91 15) shall support the commissioning process. Minimum support shall consists of the following:
1. Submit the manufacturer's installation & startup manual as a part of the initial equipment submittal.
 2. Submit the manufacturer's operating and maintenance manual as a part of the initial equipment submittal
 3. Conduct inspection of completed installations per installation check lists provided by equipment manufacturer and ensure satisfactory completion of installation as recommended by the manufacturers of various equipment.
 4. Conduct inspection of installation per the Pre-Functional Check List established by the Commissioning Authority and coordinate such inspections with the CA.
 5. Assist in developing the final functional test procedures as specified in Sections 01 91 15, Division 23, Division 26 and related sections.
 6. Provide authorized startup technician as well as other subcontractor resources as required to perform functional performance testing as specified in Sections 01 91 15, Division 23, Division 26 and related sections.

1.2. SYSTEMS WITHIN THE COMMISSIONING SCOPE OF WORK

- A. The following shall be commissioned:
1. HVAC systems including:
 - a. Single duct electric variable air volume terminal units
 - b. Rooftop packaged single zone VAV unit with return/power exhaust
 - c. Exhaust fan
 - d. Split System indoor and outdoor unit
 2. Electrical systems , including lighting, service, distribution and controls
 - a. Interior and exterior lighting system and controls
 - b. Schedule or occupancy sensor lighting controls
 - c. Daytime dimming controls
 - d. Power distribution system

- e. Emergency power generators and transfer switches
- f. Uninterruptible power supply systems
- g. Power metering systems
- 3. Plumbing, including domestic hot water systems pumps and controls
 - a. Electric water heater
 - b. Circulating pump
 - c. Water metering system
- 4. Photovoltaic and Renewable Energy Systems
- 5. Landscape Irrigation System
- 6. Building Envelope System

1.3. SUBMITTALS

Provide the following submittals in accordance with the general submittal requirements specified elsewhere in Division 1:

- A. Start-up procedures – required for acceptance of initial equipment submittal. Provide submittal for the systems and equipment listed in Part 3 under Equipment Startup
- B. Division 23 DDC System Control Logic Submittal – as specified in Division 23 and/or provided in plans.
- C. Equipment Operation and Maintenance manuals – required for acceptance of initial equipment submittal.
- D. Review of Initial Functional Performance Test (FPT) prepared by the CA.
- E. Completed startup documentation – required for acceptance of initial equipment submittal. Provide submittal for the systems and equipment listed in Part 3 under Equipment Startup.
- F. Completed Pre-Functional Check Lists – Required prior to scheduling FPTs
- G. Completed test and inspection reports on the electrical systems as conducted and reported by independent testing agencies.

1.4. DEFINITION OF TERMS

Acceptance Criteria: Acceptance of the systems is based on the contractor being able to demonstrate that the systems and their components function in accordance with the commissioning acceptance criteria.

- A. Installation and static testing acceptance criteria: The acceptance criteria for installation and static testing are the materials and methods requirements specified in Divisions 23 and 26.

- B. Functional testing acceptance criteria: The acceptance criteria for functional performance tests are described within the procedures. The functional performance test procedures include descriptions of systems and components responses that are to be verified. These are the functional testing acceptance criteria. The functional testing acceptance criteria are based on the project documents and the basis of design.
- C. The Commissioning Plan is a detailed document prepared and maintained by the CA that describes the entire commissioning process.
- D. Contractor's Pre-Functional Checklist (Also referred to as System Readiness Checklist): These checklists are provided by the CA and include equipment installation and start-up items specified to be performed and verified by the Contractor. These checklists shall be completed by the Contractor and returned to the CA prior to the final CA installation verification and functional performance testing process.
- E. CA Final Installation Verification Process: This process includes the on-site review of related system components for conformance to the Project Documents. The CA will conduct this review and verify system readiness for final functional testing procedures upon receipt of the Contractor completed Pre-Functional Checklists. The CA will document issues identified during this process and assign them to the appropriate party for resolution.
- F. Functional Performance Testing Process: Functional Performance Testing verifies that the systems perform in accordance with the project documents, the design intent, and the A/E's basis of design. The process includes the documented testing of the systems under actual and simulated operating conditions. Functional Performance Test (FPT) procedures are detailed instructions that allow experienced system technicians to perform the FPTs with repeatable results. The repeatability of the procedures and results validate the tests. Final performance testing of systems will begin only after the Contractor certifies that systems are 100% complete and ready for functional testing, and the CA has completed the subsequent installation verification process for the systems to be tested.
- G. Commissioning Issues Log: All issues raised during commissioning shall be logged and tracked until they have been resolved. A commissioning issues log shall maintained by the CA. includes the description of all issues discovered as a result of the commissioning process. The list also includes the current issues status, assignment to the responsible party and the date of final resolution as confirmed by the CA. Items listed may include issues where design, products, execution or performance does not appear to satisfy the Project Contract Documents and/or the design intent. The resolution of issues identified on this list may be the responsibility of the Contractor, design team, or the Owner.
- H. Back-Checking: Back-Checking is the process of verifying that commissioning related issues have been resolved by the responsible party. The back-checking process takes place once the Contractor has provided written notification that the an issue or issues in the Commissioning Issues Log have been resolved.
- I. Performance Period: The performance period is a set length of time designated to demonstrate proper facility operation prior to acceptance. The performance period

commences after successful completion of other functional testing. Performance data is typically collected via DDC system trend logging or data logging. Evaluation typically includes zone temperature stability, optimum start/stop, warm-up period and other related functions. As part of this process the contractor will be required to set up and provide trends of control system parameters per the direction of the CA. The specific trending needed will be outlined in the Commissioning Plan or Functional Performance Test Procedures.

- J. Seasonal or Deferred Testing: This testing is completed during conditions that do not occur during the initial functional testing period; for example during design or seasonal transition temperatures. Seasonal or Deferred FPTs are a limited sub-set of the original tests and are designed to evaluate capacity and systems' interaction.
- K. Final Commissioning Report: The Final Commissioning Report contains a summary description of the commissioning process as it occurred, and the final versions of all commissioning documentation. The Final Commissioning Report shall be prepared by the Commissioning Authority.
- L. Project Contract Documents: As defined elsewhere in Division 1.
- M. The Commissioning Team: Commissioning is performed by the Commissioning Team, which consist of the Owner, Commissioning Authority, the Commissioning Coordinator, the Design Team, all subcontractors performing work on the equipment and systems within the commissioning scope of work, and all materials and equipment suppliers supplying equipment and systems within the commissioning scope of work. The commissioning team is led by the Commissioning Authority. The Commissioning Coordinator is the on-site manager of the commissioning process.
- N. Commissioning Authority (CA): The CA is the Owner's commissioning consultant and the leader of the commissioning Team. The CA oversees the commissioning process and advises the Owner on issues involving the commissioning process, emphasizing the long-term performance and maintainability of the systems included in the commissioning scope of work. The CA is required to advise the Owner of issues involving the design, construction, testing, adjusting and balancing, or other items that could compromise the ability of the facility to meet the needs. The CA is authorized to recommend to the Owner the acceptance, modification, or rejection of all materials, procedures, schedules, tests, reports, or other required commissioning submittals. The CA is not authorized to change existing contract documents, schedules, costs, or scope of work for any of the parties involved (architect or contractor).
- O. General Contractor's Commissioning Coordinator (CC): The General Contractor shall provide a Commissioning Coordinator. The General Contractor's Commissioning Coordinator is responsible for managing the specified commissioning work. The CC is an employee of the General Contractor who is regularly and frequently on site. Qualifications for the Commissioning Coordinator include experience and excellent abilities to schedule, coordinate, and manage mechanical and electrical subcontractors. The following tasks are some of the critical items included in the CC's scope of work:

1. Providing, updating and managing the commissioning schedule
2. Providing all commissioning submittals
3. Managing training plans in accordance with the commissioning specifications
4. Managing subcontractor and supplier review of the FPT procedures and forms developed by CA, providing written comments regarding issues from all required FPT participants pertaining to safety, equipment protection and warranty, and appropriateness of the procedure for the systems as provided, and providing written comments, even if no exception is taken, for every FPT
5. Managing development, submittal, and performance of specified flushing, cleaning and start-up procedures.
6. Providing test reports and progress reports in accordance with the commissioning specifications
7. Managing FPT process as specified in the commissioning specifications. CC shall be responsible for organizing and coordinating resources required to perform specified pre-functional checks and functional testing specified by the CA.
8. Managing resolution of issues identified during commissioning
9. Managing preliminary FPTs to verify readiness for final FPT demonstrations, and submitting documented verification that systems will pass FPTs with acceptable results as documented in the FPTs.
10. Coordinating and taking charge of FPT demonstrations to Owner and CA
11. As testing occurs, tracking and collecting the results of contractor functional performance testing (FPTs), and filing the original record sheets for the Final Commissioning Report
12. Managing repeat FPTs that fail due to contract deficiencies until acceptable results are achieved.

1.5. CONSTRUCTION PHASE COMMISSIONING PROCESS OVERVIEW

- A. After the bid award and acceptance of mechanical, electrical, plumbing, irrigation, building envelope, and photovoltaic and renewable energy system submittals, the Commissioning Authority will conduct a Commissioning Kickoff coordination meeting with the Contractor, Owner's Representative and the Sub-contractors. The CA will present the commissioning plan, discuss commissioning process in detail, and identify specific commissioning related responsibilities. Milestone shall be discussed, including contractor start-up and testing forms, preliminary O&M manuals, training agendas and other approved submittals needed to complete the plan.
- B. The Contractor shall provide the Commissioning Submittals
- C. Functional performance Test procedures shall be developed by the CA with input from the Contractor, Owner, and A/E as specified in Part 3.
- D. Commissioning coordination meetings shall be scheduled to occur during the construction and closeout phase to monitor progress and to help facilitate the commissioning process. Contractor representatives for commissioned systems shall be required to attend these

meetings. Meetings will generally be scheduled to occur with scheduled construction or management meetings.

- F. The Contractors shall prepare the equipment and systems for startup in accordance with the Project Documents, industry standard guidelines, and the guidelines of the equipment and systems manufacturers. Startup shall be provided by the contractors and manufacturer's startup technicians in accordance with the Project Documents, industry standard guidelines, and the guidelines of the equipment and systems manufacturers. The Contractor shall test the systems to verify that they perform in accordance with the Project Documents, including the Commissioning Functional Performance Test Procedures. The CA may witness equipment start up and testing. The contractor shall notify the CA in writing at least five (5) working days in advance of the start-up and testing dates so that the CA can attend. If the CA is not notified in advance of a scheduled start-up or testing activity, the start-up or testing shall be rescheduled and repeated to the satisfaction of the CA. When scheduled start-up activities are not executed because of lack of preparation or coordination by the Contractor, the Contractor will be subject to back-charges in accordance with the contract documents.
- G. Once the Contractor has provided the CA with written verification (Contractor's System Readiness Checklists or Pre-Functional Checklists) indicating completion of installation procedures, the Commissioning Authority will conduct a system readiness review of the specific systems and equipment to be commissioned. Issues noted during this process will be documented by the CA in the Commissioning Issues List.
- H. Upon confirmation of the completed and verified Pre-Functional Checklists and receipt of the preliminary balancing (TAB) report, receipt of equipment startup reports, controls point-to-point checkout and BMS Graphics screenshots, functional performance testing shall be scheduled. Functional testing shall not commence until all critical issues identified during the Installation Verification Process are resolved.
- I. Contractor shall retain independent testing agencies as required to provide specialized tests related to electrical infrastructure components as specified under Division 26. These tests shall be included as part of the final commissioning close out document, prior to project acceptance.
- J. Issues noted during the functional performance tests or specialized tests provided by independent testing agencies will be documented by the CA. When easily corrected, issues will be resolved at the time of discovery. The appropriate contractor will resolve all other issues at a later time. Issues will be tracked by issue number, responsible party, status, and activity date. The contractor shall be responsible for reporting, in writing, to the CA when issues have been resolved so that the CA can verify the resolution.
- K. The construction phase commissioning process will be complete when all noted issues have been corrected, proved to be in compliance with the Project Documents or otherwise resolved to the satisfaction of the Owner. The work of the general contractor and subcontractors (including the mechanical, test and balance, controls, electrical, lighting controls, plumbing, and irrigation subcontractors) related to the commissioned systems is not complete until signed off by the commissioning agent and/or the Owner.

1.6. CLOSEOUT PHASE COMMISSIONING PROCESS OVERVIEW

- A. Closeout contractor responsibilities include completion and submission of the Project Closeout Checklist for commissioned systems. The CA shall be responsible for developing the close-out check list related to commissioning activities.
- B. Training on related systems and equipment operation and maintenance shall be scheduled after commissioning is satisfactorily completed, O&M manuals have been accepted and delivered to the Owner, and systems are verified to be complete and functional. Each Contractor is responsible to provide a topical outline of all subjects to be covered in the training session(s), the expected length of time for the training sessions, and a brief resume listing the qualifications of the proposed training presenters. Training will be coordinated with the Owner.
- C. Upon request, the Contractor is responsible for providing the CA with copies of all balancing reports, as-built drawings and O&M manuals relevant to the systems commissioned. The CA will review this material for compliance with Project Documents and will note and report all issues for resolution by the responsible party.
- D. Upon completion of all commissioning activities the CA will prepare and submit to the Owner the Final Commissioning Report detailing the commissioning plan and all commissioning activities.

1.7. BACK-CHARGING

- A. The Contractor is responsible for scheduling and coordinating commissioning activities. The Contractor shall reimburse the Owner for the cost of commissioning activities that must be repeated because of a lack of preparation or coordination by the Contractor.
- B. Repeated back-checking: Commissioning issues are documented in the Commissioning Issues Log. The Contractor shall submit a brief written statement of when and how each issue has been resolved, using issues response forms provided by the CA. The CA will back-check these issues to verify they have been resolved. If the back-checked issues that have not been resolved in the accepted manner the associated cost of the unsuccessful back-check shall be subject to back-charging

1.8. COMMISSIONING PROCESS COMPLETION

- A. The commissioning process will be complete when all noted issues have been corrected, proved to be in compliance with the Project Documents or otherwise resolved to the satisfaction of the Owner. The work of the general contractor and subcontractors (including the mechanical, test and balance, controls, electrical, lighting controls, plumbing and irrigation subcontractors) related to the commissioned systems is not complete until signed off by the commissioning agent and/or the Owner.

PART 2 – PRODUCTS

2.1. CONTRACTOR SYSTEMS READINESS FORMS

- A. The Contractor shall be responsible for maintaining and completing copies of the Contractor's Pre-Functional Check lists, which will be provided by the CA. Initial forms are provided in the project specifications for illustration of the rigor associated with such inspections, however, working drafts will be created based on actual submittal data and contractor reviews. Checklist forms and supporting documents shall be signed by the Contractor and submitted to the CA upon completion.
- B. Completion of these items shall not release the Contractor from their responsibility to complete other specified requirements of the Project Contract Documents.

2.2. STARTUP PROCEDURES AND FORMS

- A. Startup procedures and checklists for the equipment specified in part three shall be submitted for review as a part of the equipment submittal. Minimum startup procedures are specified in Divisions 23 and 26. Procedures shall also include all installation and start-up procedures and checklists that are provided by the equipment or system manufacturer. The accepted startup documentation shall be completed by the Contractor and submitted to the CA for review and inclusion within the Final Commissioning Report.

2.3. TEST INSTRUMENTATION

- A. The contractor shall provide the commissioning test equipment required to conduct the performance tests. Full line of test instrumentation may include loggers and meters for power, chilled water, hot water, gas flow, sensors for CO2 concentration, pressure, air or liquid temperature and such others reasonably required for measuring and evaluating the performance of central energy plants and building HVAC systems of the type described in the contract documents.
- B. The test equipment shall be provided in sufficient quantities to execute functional testing in an expedient fashion, consistent with the commissioning and start-up schedule approved by the Owner.
- C. The test equipment shall be suitable for testing and calibration with accuracy and tolerances necessary to demonstrate that system performance is in accordance with the basis of design.
- D. Equipment used for functional testing sensors and gages shall be certified to an accuracy of 10% of the smallest tolerance to be measured. For example, if a temperature gage is required to be ± 2 degrees F, the calibration device must have a minimum accuracy of ± 0.2 degrees F.
- E. Instrumentation used for functional testing system performance must have a minimum repeatability and accuracy of $\pm 1.0\%$ of the acceptance criteria being measured. For example:

if a supply temperature of 50F is being verified, the repeatability and accuracy of the test instrument must be at least $\pm 0.5F$

- F. The test equipment shall have calibration certification per equipment manufacturer's interval level or within one year if not specified.
- G. Contractor shall be responsible for organizing the performance data gathered during the tests in an electronic format (such as an Excel workbook format) for the commissioning agent's review and analysis.

2.4. PROJECT CLOSE-OUT CHECKLIST

- A. The Contractor shall complete and sign the Commissioning Project Closeout Checklist provided by the CA to indicate completion of Contractor's specified responsibilities regarding arrangements for post-construction testing, spare parts for Owner, final O&M manuals, as-built documents, O&M training, performance testing, indoor air quality testing and any other requirements that occur just prior to Owner acceptance of the project.

PART 3 – EXECUTION

3.1. DOCUMENTATION

- A. All checklists, start-up documentation, test forms and other commissioning related documentation required by contract shall be neatly completed and submitted to the CA in a clear and easily readable condition.
- B. All required checklists, start-up documentation, test forms and other commissioning related documentation shall be submitted to the CA in accordance with the commissioning and construction schedule.
- C. When the Contractor is unable to comply with an item as listed on the checklist or form, the Contractor shall immediately notify the CA in writing as to the reasons for non-compliance.

3.2. EQUIPMENT START-UP

- A. The contractor shall perform equipment start-up per the accepted start-up plan and start-up forms. The contractor shall correct issues as they are discovered and submit the successfully completed start-up documentation to the CA. Systems and equipment are:
 - 1. All HVAC Equipment
 - 2. All Plumbing Equipment
 - 3. Direct digital controls (DDC) and control sequences for HVAC systems
 - 4. All Electrical Equipment and systems
 - 5. PV and Renewable systems

3.3. PRE-FUNCTIONAL CHECKLISTS (PFC)

- A. The contractor shall verify the installation and start-up of each system by completing the verification procedures outlined on the PFC. The contractor shall correct issues as they are discovered and submit the successfully completed documentation to the CA.
- B. The CC shall review and sign off on all PFC prior to submittal to the CA.
- C. The CA shall review all PFC and supporting documentation from installation and start-up activities. The contractor must have approval from the CA to proceed with testing.

3.4. INSTALLATION VERIFICATION

- A. Contractor shall inspect installed equipment and systems. Contractor shall complete and submit the PFC as an indication of completion of all installation requirements as specified in the Project Contract Documents.
- B. After the Contractor has submitted the PFC, the CA will perform final installation verifications on selected systems. Discrepancies discovered will be reported in the Commissioning Issues Log.
- C. The CA shall back-check and verify that all issues are resolved prior to proceeding with FPT.

3.5. FUNCTIONAL PERFORMANCE TESTS (FPT)

- A. Functional performance testing of commissioned systems shall begin after all critical issues discovered during the installation verification process have been corrected.
- B. The CA shall develop an FPT for each piece of equipment or system being commissioned (example, AHU, VAV, Exhaust fans, etc.) and may also develop FPT for integrated systems, overall systems, and individual sequences within a control system. The scope and detail within FPT shall be comprehensive enough to demonstrate to the Owner the full range of operability and performance of the installed equipment and systems intended to be commissioned, including not only the peak operating capacity, but also the flexibility to accommodate varying load situations.
- C. The procedure for developing and performing the FPT shall be as follows
 - 1. The Contractor shall provide the equipment and commissioning submittals as specified in the project documents
 - 2. The CA shall draft the FPT based on the submittals.
 - 3. Each contractor and equipment supplier that is specified as an FPT participant in the FPT Summary Table of this section shall participate in the development and performance of the associated FPT. Each FPT participant shall provide written comments on the associated FPT regarding each of the following issues:

- a. Verify that the procedures can be performed without compromising the safety of the participants
 - b. Verify that the procedures can be performed without compromising the warranties of equipment, components, and systems
 - c. Verify that the procedure is appropriate for the equipment, components, and systems as provided.
 - d. At the contractor's option, make recommendations to incorporate the FPTs into the contractor's in-house startup and QC testing process
4. The CA shall complete the working drafts of the FPTs
5. Subcontractors and suppliers shall provide the personnel, expertise, and test equipment to operate and maintain the systems during testing.
6. The Contractor shall perform a dry run of the FPTs until the acceptable results documented in the FPT procedure have been obtained and recorded. If necessary to obtain acceptable results, the Contractor may consult with the CA to acquire clarification and resolve issues.
7. The Contractor shall submit the completed dry run FPT record forms which document acceptable dry run FPT results.
8. After the CA has accepted the Contractor's submittal of recorded results, the FPTs shall be demonstrated to the CA. If acceptable results are not demonstrated for an FPT, the Contractor shall resolve the issue(s) and the demonstration shall be repeated.
9. The contractors shall perform the FPT and submit the record sheets for all equipment components and systems. If permitted by the CA and depending on the nature of equipment and systems tested, FPT may be demonstrated for a sample of the systems that comply with all of the following criteria. This process is referred to in this document as "demonstration sampling."
 - a. The systems shall not be a part of a fire alarm, life safety, or security system
 - b. There shall be many of the systems with similar components that have identical sequences of operation
 - c. The components and systems to be included in the Demonstration Samples shall be chosen by the CA at the time of demonstration
 - d. The trend logging portions of all FPTs shall be completed for 100% of the systems
 - e. The sample size shall be in accordance with the Functional Performance Test (FPT) Demonstration Sampling Table. The actual number of units to be sampled shall be calculated by rounding the percentage of total units up to the next whole number.
 - f. Acceptable results must be demonstrated for the entire sample. If the FPT results are not acceptable due to a lack of preparation or coordination by the Contractor for any system or component sampled, the FPT shall be demonstrated for all of the systems and components for which it was written. Whenever the demonstrated results are not acceptable, the contractors shall make corrections and the FPT shall be demonstrated again.
 - g. The trend logging portions of all FPTs shall be completed for 100% of the systems.
 - h. Functional Performance Test (FPT) Demonstration Sampling Table shall be provided in the FPT by the CA for each type of system commissioned. Unless otherwise provided in

this specification or authorized in writing, Contractor shall assume that 100% of systems to be commissioned are tested per the FPT.

10. The CC is responsible for scheduling and coordinating functional testing activities. The Contractor demonstrates the functional performance tests after they have verified that performing the FPTs will yield the documented acceptable results.

- D. In addition to participating in functional tests developed by the CA, the Contractor shall be required to complete all start-up and testing procedures as specified elsewhere in the Project Contract Documents.

3.6. ISSUE CORRECTION

- A. Issues entered into the Commissioning Issues Log, shall be resolved by the contractor in a timely manner. The Contractor shall submit a brief written statement of when and how each issue has been resolved, using issues response forms provided by the CA.

3.7. PERFORMANCE PERIOD

- A. The CA shall prepare a performance period test plan including measured variables and success criteria based on performance characteristics described in the Project Documents. The CA will provide the Control System Contractor with a list of required trend log definitions to be implemented as a basis for reviewing performance during this period.
- B. The Contractor will review the performance period test plan and set up the trend log definitions from the CA. The trending shall be provided by the contractor in both a text and graphic format with related system parameters grouped together for easy comparison. If DDC system resident memory is limited or there are other issues with the trending requirements, the Contractor will notify the CA and request the CA redefine the test plan.
- C. The performance period will typically commence within one week of the final functional tests and run for a minimum of 5 days. If failures are encountered, the performance period shall be aborted. After corrections are made, the performance period shall be re-started on day one.

3.8. SYSTEMS ACCEPTANCE

- A. Equipment and systems shall not be accepted by the Owner until all commissioning activities are complete and the performance period standards have been met.

3.9. PROJECT CLOSEOUT

- A. Post construction contractor responsibilities include completion and submission of the Project Closeout Checklist for each commissioned system to the CA for verification of completing contracted obligations for the Owner.

- B. Training shall only be scheduled to commence after functional testing is satisfactorily completed, O&M manuals have been delivered and approved, and systems are verified to be 100% complete and functional. Each Contractor is responsible to provide a topical outline of all subjects to be covered in the training session(s), the expected length of time for the training sessions, and a brief resume listing the qualifications of the proposed training presenters. The CC is responsible for developing the training plan with input from the contractor and directing any videotaping efforts. The CC is responsible for coordinating training with the Owner and CA and to verify execution of the training plan.
- C. Upon request, the Contractor is responsible for providing the CA with copies of all balancing reports, as-built drawings and O&M manuals relevant to the systems commissioned. The CA will review this material for compliance with Project Documents and will note and report all issues for resolution by the responsible party.
- D. Upon completion of all commissioning activities the CA will prepare and submit to the Owner the Final Commissioning Report detailing the commissioning plan and all commissioning activities and recommending acceptance to the Owner. The CC will support this effort by coordinating the contractor provided documentation.

3.10. DEFERRED AND SEASONAL TESTING

- A. Deferred or Seasonal testing requirements shall be conducted to ensure that systems operate per design intent during both peak cooling and peak heating seasons. Contractor shall provide required resources to the CA to facilitate seasonal testing.
- B. The Contractor shall provide labour and material for seasonal testing and make corrections to any Contractor related issues discovered.

3.11. NEAR-WARRANTY-END REVIEW

- A. Within two months prior to the end of warranty on commissioned systems, the facility staff shall participate in a review on the operation and condition of outstanding issues related to the original and seasonal commissioning with the CA to identify any operational and outstanding issues.
- B. Issues identified in this review will remain warranty items until satisfactory completion, even if the warranty period expires during the review and correction period.

END OF SECTION

SECTION 01 91 15 – BUILDING ENCLOSURE COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the commissioning requirements for the Building Enclosure systems.
 - 1. The commissioning requirements for the Building Enclosure systems given in this Section are entirely separate from, and in addition to, the General Commissioning Requirements for this project.
 - 2. The Commissioning Provider (CxP) and Building Enclosure Commissioning Provider (BECxP) will provide separate documentation for each commissioning process.
- B. This section includes the Building Enclosure Commissioning (BECx) requirements and the Functional Performance Testing Requirements for the building enclosure systems. This Section shall in no way diminish the responsibility of Division 03, 04, 07, 08, and 09 Contractors, Subcontractors, Suppliers and Fabricators in performing all aspects of work and testing as outlined in the Contract Documents. Any requirements outlined in this Section are in addition to requirements outlined in Division 03, 04, 07, 08, and 09 for building enclosure materials, warranties, installation, and testing requirements.
- C. Owner will contract services of the BECxP and BECx Testing Agency (BECxTA) through the CxP. The BECxP will direct and coordinate commissioning activities and report to the OR. All members of the Building Enclosure Commissioning Group (BECxG) shall cooperate to fulfill contracted responsibilities and objectives of the Contract Documents.

1.3 GENERAL DESCRIPTION

- A. BECx is a process that is performed on behalf of the Owner that implements a quality focused process for enhancing the delivery of a project by focusing on validating during the design phase and verifying during construction phase that the performance of building enclosure materials, components, assemblies, and systems are designed and installed to meet the Owners expectations as described in the building enclosure OPR and as defined by the contract documents.
- B. Commissioning does not take away from, or reduce responsibility of, system designers or installing Contractors to provide a finished and fully functioning product.

1.4 RELATED WORK AND DOCUMENTS

- A. Specific building enclosure commissioning requirements are provided in this Specification. The following Specification Sections are related to the commissioning work specified in this Section:
1. Section 01 19 13 General Commissioning Requirements
 2. Division 03-09 specification sections for Building Enclosure materials, warranties, installation, and testing requirements that are separate from requirements of this section.
 3. Section 03 30 00 Cast-In-Place Concrete
 4. Section 04 20 00 Unit Masonry
 5. Section 07 13 26 Self-Adhering Sheet Waterproofing
 6. Section 07 21 00 Building Insulation
 7. Section 07 24 00 Exterior Insulation and Finish System (EIFS)
 8. 07 41 00 Standing Seam Metal Roof System
 9. Section 07 62 00 Sheet Metal Flashing and Trim
 10. Section 07 92 00 Joint Sealants
 11. Section 08 44 00 Curtain Wall Assemblies
 12. Section 08 80 00 Glazing
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section. Division 3, 4, 7, 8, and 9 Specification Sections also apply to this Section. Where conflicts arise regarding BECx or BECx Functional Performance Testing (FPT), this Section shall supersede other Sections where contradictions occur.

1.5 ABBREVIATIONS

- A. The following are common abbreviations used in this Section:
1. A/E – Architect/Engineer
 2. BECx – Building Enclosure Commissioning
 3. BECxP – Building Enclosure Commissioning Provider
 4. BECxG – Building Enclosure Commissioning Group
 5. BECxTA – Building Enclosure Commissioning Testing Agency
 6. BOD – Basis of Design
 7. CxP – Commissioning Provider
 8. Cx – Commissioning
 9. FPT – Functional Performance Testing
 10. OPR – Owner's Project Requirements
 11. OR – Owner's Representative
 12. O&M – Operations & Maintenance
 13. RFI – Request for Information
 14. QA – Quality Assurance
 15. QC – Quality Control

1.6 REFERENCE STANDARDS

- A. American Architectural Manufacturers Association (AAMA)
 - 1. AAMA 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
 - 2. AAMA 503 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems
 - 3. AAMA 511 Voluntary Guideline for Forensic Water Penetration Testing of Fenestration
- B. ASTM International
 - 1. ASTM C1521 Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
 - 2. ASTM E783, Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
 - 3. ASTM E1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference
 - 4. ASTM E2813 Standard Practice for Building Enclosure Commissioning
 - 5. ASTM E2947 Standard Guide for Building Enclosure Commissioning
- C. International Organization for Standardization (ISO)
 - 1. ISO 6781 Thermal Insulation – Qualitative Detection of Thermal Irregularities in Building Envelopes – Infrared Method

1.7 DEFINITIONS

- A. Action Item: Any issue that requires a response, completion, corrective or additional work, or any other action related to the construction. Examples include a Contractor's Request for Information (RFI), an Architect's Field Directive, a clarification request, or a documented deficiency in the Work. Action Items must be categorized and assigned to the appropriate party for remedial action.
- B. Action Item Log: List maintained and updated by the BECxP that includes all Action Items that relate to BECx activities, including a summary description of each action item (including photograph where appropriate), the date that each Action Item was first documented, the appropriate party responsible for remedial action, the date corrective action was performed, and a brief summary of the remediation.
- C. Approval: Acceptance that a material or system has been properly installed and is functioning in tested modes according to the Contract Documents.
- D. Architect/Engineer (A/E): Prime consultant (architect) and sub-consultants who comprise the design team, generally the Architect of Record and any Design Sub-consultants.
- E. Basis of Design (BOD): Documentation of primary thought processes and assumptions behind design decisions made to meet design intent. Describes systems, components, conditions, and methods chosen to meet the OPR.

- F. Building Enclosure Commissioning Provider (BECxP): Retained by the Owner to oversee and manage the BECx process, develop many of the BECx requirements, and validate that building enclosure systems are designed, installed, and tested to meet the Owner's requirements and/or contract documents provided by the A/E. The BECxP directs and coordinates day-to-day building enclosure commissioning activities independently from CxP.
- G. Building Enclosure Commissioning Group (BECxG): The BECxG is comprised of members of the project team assigned the responsibility for the implementation of the enclosure commissioning process. The BECxG is typically established by the Owner to oversee and accomplish the tasks outlined in this specification.
- H. Building Enclosure Commissioning Plan (BECx Plan): The overall plan developed after bidding that provides structure, schedule, and coordination planning for the building enclosure commissioning process. The BECx plan will be provided separately from Cx Plan.
- I. Building Enclosure Commissioning Testing Agency (BECxTA): Individuals and/or accredited testing agencies who possess the skills, knowledge, experience and certification, as required, to perform the testing outlined in this specification.
- J. Commissioning Provider (CxP): Contracted to Owner. CxP directs and coordinates day-to-day commissioning activities excluding BECx activities. CxP reports directly to Owner.
- K. Commissioning Plan (Cx Plan): Overall plan developed after bidding that provides structure, schedule, and coordination planning for commissioning process. The BECx plan will be provided separately from other Cx plans.
- L. Contract Documents: Documents binding on parties involved in construction of this project (e.g., drawings, specifications, change orders, amendments, contracts, etc.).
- M. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore refer to the general contractor, subcontractors, or vendors as inferred by its usage.
- N. Deficiency: Condition of a building enclosure material or system that is not in compliance with Contract Documents (i.e., does not perform properly or is not complying with design intent).
- O. Functional Performance Test (FPT): Test of installed (either mock-up or field) building enclosure materials and systems. Systems are tested under various simulated environmental conditions.
- P. Owner/Owner Representative (OR): Representative for the owner of a construction project
- Q. Owner's Project Requirements (OPR): A written document that details the functional requirements of a project and the usage and operational expectations. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.
- R. Simulated Environmental Condition: Condition created for testing a component or system (e.g., applying pressure differential across the building enclosure concurrent with water spray to simulate a wind-driven rain).
- S. Specifications: Construction specifications of Contract Documents.

1.8 BUILDING ENCLOSURE COMMISSIONING GROUP

A. Building Enclosure Commissioning Group (BECxG): Members of the BECxG will consist of:

1. Owner Representative(s) (OR)
2. Architect and Design Engineers (A/E)
3. Building Enclosure Commissioning Provider (BECxP)
4. Contractor
5. Building Enclosure Commissioning Testing Agency (BECxTA)
6. Commissioning Provider (CxP)
7. Building Enclosure Subcontractors

1.9 RESPONSIBILITIES OF BUILDING ENCLOSURE COMMISSIONING GROUP MEMBERS

A. Owner Representative (OR)

1. Develop OPR
2. Assist in dispute resolution regarding building enclosure items.
3. Attend BECx review and coordination meetings.
4. Participate in pre-construction mock-up and field testing coordination meetings.
5. Review BECxP and BECxTA reports.
6. Facilitate Occupancy and Operations Phase warranty and maintenance review meeting and onsite qualitative assessment of enclosure-related materials, components, systems, and assemblies.

B. Architect/Engineer (A/E)

1. Document design intent of systems.
2. Review and incorporate building enclosure commissioning specification, which includes functional performance test requirements, into the construction documents.
3. Provide construction documents electronically.
4. Review and respond to the design review comments provided by BECxP. If A/E disagrees with BECxP's comments, A/E shall provide reasonable explanation for consideration by BECxP and Owner.
5. Review submittal comments provided by BECxP and include comments as appropriate in submittal response. If A/E disagrees with BECxP's comments, A/E shall provide reasonable explanation for consideration by BECxP and Owner.
6. Assist in dispute resolution regarding building enclosure items.
7. Attend BECx review coordination meetings.
8. Participate in pre-construction mock-up and field testing coordination meetings.
9. Review BECxP and BECxTA reports.

C. Building Enclosure Commissioning Provider (BECxP)

1. Perform that following BECxP tasks in accordance with the BECx Plan:
2. Develop design phase BECx Plan and update throughout the project as necessary.
3. Review and comment on the BOD for the project and review and document the OPR for the building enclosure.

4. Provide review comments on the various contract document A/E submissions (e.g. design documents, energy models, glazing reports, etc.) as defined by the contract between BECxP and Owner related to the building enclosure for compliance with the BOD and OPR. Refer to Part 1.11B for further information. The BECxP and CxP shall review the design, identify design issues and/or conflicts that would present a problem for the total system commissioning.
5. Develop the project specific BECx specification section (this section), which includes requirements for FPT.
6. Develop and maintain an Enclosure Design Issues Log, documenting identified issues, responses, and resolution.
7. Attend regularly scheduled meetings/conference calls/web-based communication at milestones appropriate for the complexity of the project and to maintain schedule milestones as outlined in the BECx Plan.
8. Provide comments on submittals related to building enclosure. Provide written comments to A/E for their consideration in their review of the submittals. Refer to Part 1.11C for further information.
9. Review and comment on enclosure related RFIs, bulletins, and change order proposals as outlined in the BECx Plan.
10. Review proposed substitutions and value engineering as outlined in the BECx Plan.
11. Review and document construction of the mock-up against the design documents, shop drawings, recommended manufacturer's installation instructions, and the industry accepted standard of care. All mock-up testing will be witnessed and documented by the BECxP.
12. Convene Preconstruction Commissioning Conference: BECxP will schedule a preconstruction BECx conference before construction of the building enclosure starts, at a time convenient to Owner, A/E and Contractor. The BECxP will conduct the meeting to review commissioning responsibilities and personnel assignments
 - a. Attendees: Authorized representatives of Owner, BECxP, Contractor, A/E, and Contractor's superintendent; major building enclosure subcontractors; suppliers; 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 commissioning.
 - b. Agenda: Discuss items of significance that could affect progress, including the following:
 - i. Commissioning Plan and related Specifications
 - ii. Tentative construction schedule per Contractor.
 - iii. Phasing and "Building Dry" milestone per Contractor.
 - iv. Critical work sequencing and long-lead items per Contractor.
 - v. Designation of key personnel and their duties.
 - vi. Field testing schedule, including any special provisions necessary for tests.
 - vii. Procedures for testing and inspecting.
 - viii. Submittal procedures.
 - ix. Coordination of Record Documents.
 - x. Owner's occupancy requirements.
 - c. Minutes: BECxP will record and distribute meeting minutes
13. Review/develop quality control installation checklists for the building enclosure products and assemblies

14. Witness building enclosure functional performance testing, milestone installations, and perform site visits to track and document the progress of building enclosure construction. During the QA site visits, BECxP will review the exterior enclosure for conformance to the design documents, shop drawings, recommended manufacturer's installation instructions, and the industry accepted standard of care. The BECxP reporting system is to individually track each condition observed in the field with the intent on completing the project with no outstanding Action Items.
 - a. Develop and distribute BECx Report (*reference Section 1.11F*).

D. Contractor

1. Appoint personnel knowledgeable of the building enclosure to serve as representative(s) to the BECxG throughout the project. Contractor representative(s) to attend all BECxG meetings.
2. Incorporate commissioning activities into the construction schedule and update as required.
3. Provide summary and schedule of laboratory and field quality control tests and inspections required by the Contract Documents to BECxP. Provide overview of general areas available to be tested on elevation sheets and correspond with overall schedule.
4. Coordinate and chair preconstruction and construction-phase coordination meetings.
5. Participate in pre-construction mock-up and field testing coordination meetings.
6. Coordinate with the BECxP pre-construction and construction testing.
7. Develop and maintain field check lists for building enclosure assemblies.
8. Submit laboratory and field quality control testing reports, field checklists, and inspection reports on building enclosure construction to the BECxP.
9. Perform out of sequence work as required to facilitate field tests.
10. Sequence work so as to not preclude the area to the interior of the test from being accessed or require the removal of work to perform tests.
11. Coordinate with Subcontractors/Vendors to perform the following:
 - a. Review BECx Plan.
 - b. Attend commissioning kick-off meeting and other BECxTA meetings.
 - c. Notify Contractor and BECxP of work completion.
 - d. Attend all applicable material and systems FPT.
 - e. Execute all periodic maintenance and/or repairs as required on systems from initial mock-up to final acceptance by Owner to prevent material warranties from being voided.
 - f. Ensure installation work is complete, in compliance with Contract Documents, and is ready for FPT. Notify BECxTA that systems are ready for FPT.
 - g. Provide all warranty and maintenance information/submittals for inclusion into the final BECx Report for the Owner.
12. Submit copies of initial submittals for building enclosure systems for BECxP review and final A/E approved submittals (*reference Section 1.11C below*).
13. Review BECxP submittal comments (*reference Section 1.11C below*).
14. Ensure resolution of non-compliance and deficiencies in construction and/or test results; obtain written documentation of completion from the appropriate Sub-Contractors.
15. Review and respond to AI in a timely manner (typically within 10 business days).
16. Obtain letters of compatibility and adhesion from responsible parties for adjacent building enclosure materials and assemblies.
17. Facilitate all repairs and retesting of failed condition(s) and pay for all associated costs (*reference Section 1.13 below*).
18. Attend Occupancy and Operations planning meeting with BECxP and OR.
19. Provide equipment as necessary to enable access to the work for BECxP review.

20. Contractor is responsible for the cost of all re-tests and compensation of time for Architect and BECxP related to all additional work necessitated by re-testing of specimens following an initial test failure.
21. Provide all necessary resources for the implementation of testing as outlined by the specifications, including but not limited to water (at appropriate pressure), electricity, access to interior and exterior of the test area (*reference Section 1.13*).
22. Provide and maintain a current testing log of all tests identified in the specifications. As tests are performed, update the log routinely in preparation for review at BECx meetings.
23. Provide and maintain a current testing log documented on the drawing elevation and roof sheets to identify the tests completed. Key area on plans to corresponding test number in log.
24. Provide all warranty and maintenance information to BECxP (*reference Section 1.11*).

E. Building Enclosure Commissioning Testing Agency (BECxTA)

1. Attend commissioning kick-off meeting and other BECxTA meetings.
2. Provide on-site technician and equipment to complete FPT.
3. Prepare and submit reports at the conclusion of all testing.
4. Perform retesting and prepare corresponding reports.

1.10 SCOPE

- A. Below Grade Systems, Roofing Systems, Opaque Wall/Cladding Systems, Weather Resistive Barrier Systems, Fenestration Systems, and all other systems, assemblies, materials, and products responsible for providing the following building enclosure functions:
1. Water Control
 2. Air Control
 3. Vapor Control
 4. Thermal Control
- B. Material, Product, and Assembly Performance Testing as required by individual sections, and/or as outlined in Part 3 of this specification. All performance values shall be as described within each relevant section of the Project Specification.
- C. Record Documents related to BECx.

1.11 DOCUMENTATION

- A. BECxP shall provide preliminary BECx Plan in collaboration with the BECxG to incorporate BECx activities into the preliminary commissioning schedule. The Contractor will integrate commissioning activities into master construction schedule. Necessary notifications are to be made in a timely manner to expedite commissioning.
- B. BECxP shall perform a peer review and provide comments related to the durability, constructability, performance, and building enclosure conformance with the Owner Project Requirements for consideration by the Owner, A/E, and Contractor.

- C. The Contractor shall provide to the BECxP the following as specified herein, and in other building enclosure technical sections of the specification (Divisions 03-09), for review and comment by the BECxP:
1. Shop Drawings and Submittals: Provide shop drawings and submittal data for materials, products, systems, and equipment that will be part of the BECx process.
 - a. The Contractor shall forward to the BECxP one copy of Shop Drawings and submittals (including warranty submittals) concurrent with distribution to the A/E. BECxP shall review and provide comments to the Owner and A/E, who will then review and incorporate the BECxP comments at their discretion and return to the Contractor. The Contractor shall then copy BECxP with the reviewed submittal with A/E submittal review stamp.
 - b. Any action taken by the A/E or Contractor based in whole or in part on the comments and recommendations provided by the BECxP as part of its submittal review shall be the sole responsibility of the A/E or Contractor.
 2. Schedule Updates: The Contractor shall issue periodic updates to the construction schedule every two week or less as appropriate. All building enclosure testing to be completed by the Contractor shall be included in the overall schedule as "testing milestones." Contractor shall use schedule to notify BECxG of scheduled tests and milestone installation events. Contractor shall coordinate with BECxP for meetings as appropriate prior to and during construction.
 3. Action Item Response: Respond to Action Items to which BECxG members assign the Contractor responsibility within 10 business days of issue.
 4. BECxTA Reports: Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to acceptance by A/E and installation.
- D. RFI and Substitution Requests: Contractor shall forward to the BECxP all building enclosure related RFI's and substitution requests concurrent with distribution to the A/E. BECxP shall review and provide comments to the Owner and A/E, who will then review and incorporate the BECxP comments at their discretion and return to the Contractor. The Contractor shall then copy BECxP with the reviewed RFI with A/E submittal review stamp.
- E. Record Drawings: The Contractor shall maintain at the site an updated set of record or 'As-Built' documents reflecting actual installed conditions and all approved changes and modifications to the contract documents. The Contractor shall provide access to the BECxP to review the As-Built, As-Constructed, and Record Drawings. The Record Drawings shall be maintained concurrently with construction.
- F. BECx Report Content
1. Maintenance Schedule: Contractor will provide a summary table that indexes the building enclosure component requiring maintenance and indicates the frequency each component will require repair or replacement (i.e., replacement of sealants, gaskets, Insulated Glass Units (IGU), repair of paints or coatings). Contractor will provide subcontractors with a maintenance information spreadsheet (provided by BECxP) that will be completed by each applicable subcontractor and returned to the Contractor for incorporation in the Commissioning Report by the BECxP.

2. Maintenance Information: Contractor shall provide Maintenance Information for each entry containing the following:
 - a. Product Data Sheet: Provide a summary of performance data.
 - b. Extended Warranty Information: Include all warranties for products, equipment, components, and sub-components whose duration exceeds one year. Include warranties on components with the system they are a part of. Reference all specific operation and maintenance procedures that must be performed to keep the warranty valid.
 - c. Sources of Material: Include reference to contact information where specific materials can be obtained.
 - d. Installation and Maintenance Instructions: For each material, component, assembly, or system.
3. Construction Documentation
 - a. Record Drawings: Contractor shall provide an index of all record drawings with drawing number, title, and electronic file name(s) including electronically referenced drawings.
 - b. Record Specifications: Contractor shall provide a detailed index of the record specification. Include sections and major items in the specification all indexed to the appropriate page number.
 - c. Approved Product Data and Shop Drawings:
 - i. Contractor shall provide an index of all product data and shop drawings. This shall list all building enclosure materials, components, or systems with the associated submittal number.
 - ii. Contractor shall organize and compile only approved product data and shop drawings. Providing these in a filing format is acceptable provided all files are identified and organized for easy access.
4. Commissioning Record: BECxP shall provide complete commissioning records including all Performance Test documentation in electronic format at the discretion of the Owner.

1.12 COORDINATION MANAGEMENT PROTOCOLS

- A. Unless otherwise defined and agreed to by the parties to the contract documents for this project, coordination responsibilities and management protocols relative to BECx are defined below, subject to further refinement during the Construction Phase BECx pre- construction meeting.
 1. Submittals and Shop Drawings: The BECxP shall review submittals and shop drawings in accordance with paragraph 1.11.C above
 2. Non-Conforming Items or Deficiencies identified by the BECxP: When the BECxP identifies a deficiency, the Contractor shall make a good faith assessment of responsible parties. Those parties shall be notified of the perceived deficiency. This communication is for information only and is not a direction to resolve the deficiency. Contractor may accept responsibility and resolve the deficiency voluntarily. If Contractor contests either the deficiency or responsibility for that deficiency, Contractor shall respond to that affect in writing to the BECxP. If a consensus is not reached as a result of this process, then the Contractor shall issue a work directive or RFI response via the normal contractual channels to resolve the issue.
 3. Requests for Meetings (beyond regularly scheduled meetings): In general request by the Contractor for additional meetings with the BECxP shall be routed through the Owner who will then confirm the necessity for the meeting. Note that every attempt should be made to deal with BECx issues at regularly scheduled BECx Meetings.

4. Scheduling Coordination – Contractor shall review the building enclosure technical specifications, identify required BECx items (including field and laboratory test requirements, specified test standards, mock-ups, product submissions, milestone installations and similar) and provide a schedule to the BECxP with anticipated dates for each. It is the responsibility of the Contractor to provide adequate time from submission of each BECx requirement to response from the BECxP, and resolution of any identified deficiencies without unnecessary negative impact on the project schedule.
5. Notification of Completion Milestones – Contractor shall notify Owner and BECxP at least two (2) weeks prior to an anticipated BECx activity or BECx milestone (such as installation of a new facade component). Contractor and BECxP shall then coordinate the scheduling of the activity between all required parties as applicable. Notification shall be via e-mail.
6. Action List: BECxP maintains a categorized Action List which tracks the BECx related action items. Any party that is copied on an email resulting from an Action Item posting may respond to it and contribute to the dialogue.
 - a. Should the Contractor choose to use a different mechanism for tracking issues for the project (i.e., Procore, eBuilder, BIM360, etc.) all action items shall be independently tracked by the Contractor and responded to in the format provided by the owner or BECxP. The BECxP is not responsible for reviewing and responding to items in other formats than the one originated by the BECxP.

1.13 FUNCTIONAL PERFORMANCE TESTING

- A. Objectives and Scope: The objective of building enclosure Functional Performance Testing (FPT) is to demonstrate each building enclosure system and system-to-system interfaces meet the performance requirements of the Contract Documents and OPR. FPT facilitates the advancement of systems from a state of substantial completion to fully operational. Additionally, during FPT, areas of deficient performance are identified and corrected, improving operation, and functioning of systems.
- B. Development of Test Procedures: The purpose of a specific test is to verify and document compliance of the installed enclosure systems with the OPR.
- C. Water leakage is only acceptable if ALL of the following conditions are satisfied:
 1. Water is contained and drained to the exterior.
 2. There is no wetting of an interior surface that is visible to the building occupants.
 3. There would be no staining or other damage to the completed building or finishes.
- D. Non-Conformance
 1. Corrections of minor deficiencies identified prior to testing may be made at discretion of BECxP. In such cases, deficiency and resolution will be documented.
 2. Every effort will be made to expedite testing and minimize unnecessary delays, while not compromising integrity of tests. BECxP shall not overlook deficient work or lessen acceptance criteria to satisfy scheduling or cost issues unless directed to do so by the Owner.

3. Deficiencies are handled in the following manner:
 - a. When there is no dispute about a deficiency and Sub-Contractor accepts responsibility for remedial action:
 - i. BECxP documents deficiency and Sub-Contractors response and intentions. BECxP submits deficiency report to Contractor, CxP and Owner. Copy is provided to Sub-Contractor by Contractor. Sub-Contractor corrects deficiency and certifies that material or assembly is ready to be retested. Contractor informs BECxTA of retesting schedule.
 - ii. Contractor reschedules test with BECxP and BECxTA
 - b. When a deficiency is disputed regarding either the nature of the deficiency or the responsible party:
 - i. BECxP documents deficiency and Contractor's response. BECxP submits deficiency report to Contractor and Owner. Report is provided to Sub-Contractor by Contractor.
 - ii. Contractor facilitates resolution of deficiency. Other parties are brought into discussions as needed. Final interpretive authority rests with A/E. Final acceptance authority rests with the Owner.
 - iii. Contractor documents the resolution process.
 - iv. Once interpretation and resolution has been decided the appropriate party or parties correct the deficiency, Contractor reschedules test, and test is repeated until satisfactory performance is achieved.

E. Cost of Testing

1. Costs for the initial testing as indicated herein shall be the responsibility of the Owner.
2. The Contractor is to provide the BECxTA with complete and unobstructed access to the test specimens. Access may include, but is not limited to, hoists, scaffolding, swing stage, extended lifts, etc.
3. The Contractor is to provide the BECxTA with the following:
 - a. General Requirements
 - i. With complete and unobstructed access to the test specimens. Access may include, but is not limited to, hoists, scaffolding, swing stage, extended lifts, etc.
 - ii. On- site parking for fully-equipped test vehicle.
 - iii. Interior finish material must be removed prior to our arrival (if applicable).
 - iv. Repair of any damage which may result from testing.
 - b. Assembly Air/Water Testing
 - i. A 10,000 lb. capacity all-terrain forklift with outriggers and a qualified operator for AAMA 501.1 dynamic water penetration testing (if applicable).
 - ii. Source of water capable of delivering 5 gal/hr/sq. ft. to the spray rack assembly and/or 30 to 35 psi to the nozzle (within 200 feet of the test area). A 1-1/2" water supply may be required at some areas
 - iii. 110/120 volt 20 amp power supply located within 100 feet of each specimen

F. Cost of Retesting and Additional Tests Required

1. Where testing indicates that performance requirements are not met, the Contractor shall repair or replace the failed section(s) and a re-test shall be conducted. Any repairs should be conducted with inspection and documentation by the Contractor and provided to the BECxP. Retesting shall be conducted by the BECxTA.

2. When a specimen fails to meet performance requirements an additional specimen of similar composition will need to be tested. For example, if one window fails to pass a test, the original test specimen in addition to one more test specimen at a random location are to be tested. The addition of test specimens resulting from failures will continue until all such specimens achieve a pass.
3. Costs for all retesting, in their entirety, will be the full responsibility of the Contractor and Sub-Contractors. These costs include all access, equipment, labor, and materials required to complete the retesting, testing of the additional specimens, and all retest costs incurred by the BECxP, BECxTA, Owner, and A/E.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

A. Field Functional Performance Testing Requirements

1. All FPT shall be conducted to project performance requirements as set forth herein and within the Construction Documents.
2. Satisfactory results of these tests do not in any way relieve the Contractor from conforming with all requirements of the Contract Documents, shop drawings, and project specifications. Installation of the work on the remainder of the building is to be done exactly as in the area checked unless otherwise instructed in writing.
3. Field functional performance testing shall be performed in accordance with referenced methods.
4. Field Functional Performance Testing Procedure:
 - a. Self-Adhered Air/Water Barrier and Waterproofing Membrane Testing:
 - i. ASTM E1186, 4.2.7: Chamber depressurization in conjunction with leak detection liquid
 - a. Testing Extent: Perform a minimum of twenty (20) air leakage tests on the opaque wall.
 - ii. ASTM E1105 water testing on a 10'-0" x 10'-0" area of the building. Testing shall be performed at 10%, 50%, and 90% completion for a total of three (3) tests.
 - iii. ALTERNATE to ASTM E1105: AAMA 501.1; dynamic pressure water testing at each location. (Note: This testing is limited to a height of approximately forty (40) feet due to equipment reach.) BECxP will determine where AAMA 501.1 can be performed in lieu of ASTM E1105.
 - b. Sealant Testing:
 - i. ASTM C1521, Method A Tail Procedure
 - ii. Perform ten (10) tests on each side of the building for each kind of sealant and joint substrate.
 - iii. Testing may be conducted by the sealant MFG or as contracted by the owner.

- c. Fenestration Testing:
 - i. ASTM E783/E1105; static pressure air and/or water testing; including each fenestration system and perimeter air and/or water control layers. ASTM E783 may not be appropriate in all cases; BECxP will decide its inclusion based on component type and size. Testing is recommended to be performed at 10%, 50%, and 90% completion where greater than one (1) test is performed per fenestration type; total minimum test areas per fenestration type outlined below:
 - a. Exterior doors (Three (3) exterior doors)
 - b. Storefront/Curtain walls (Fifteen (15) test areas (10'-0" x 10'-0" area))
 - c. Sloped glazing assemblies (One (1) test area)
 - d. Hangar doors (One (1) door)
 - ii. ALTERNATE to ASTM E1105: AAMA 501.1; dynamic pressure water testing at each location. (Note: This testing is limited to a height of approximately forty (40) feet due to equipment reach.) BECxP will determine where AAMA 501.1 can be performed in lieu of ASTM E1105.
 - iii. AAMA 501.2; nozzle spray testing; test 1000 linear feet of building enclosure system interfaces as identified by the BECxP.

B. Field Testing Performance Requirements Summary Table

1. The performance criteria below apply to the free-standing mock-up and field testing of exterior enclosure components. The Owner reserves the right to add in additional testing at the Owner's expense.
2. Performance criteria summary table according to each component:

Component	Building Performance Criteria		
	Air	Water	Adhesion Testing
Fenestration	ASTM E1186 (4.2.6) – No major air leaks at an air pressure differential of 1.57 psf. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s).	AAMA 501.2 – No water leakage. AAMA 511, Optional Sill Dam Test – No water leakage.	ASTM C 1521 – Perimeter joint sealant must maintain adhesion and achieve 100% cohesive failure.
	E783 – Maximum air leakage of 0.09 cfm/sq. ft at an air pressure differential of 6.24 psf.		

Weather Barrier/ Waterproofing Membrane Assemblies	ASTM E1186 (4.2.7) – Pass/fail criteria shall be no bubbles observed in the leak detection liquid at a pressure differential of 6.24 psf.		
	ASTM E783 – Maximum air leakage of 0.04 cfm/sq. ft. at an air pressure differential of 1.57 psf.		
	ASTM E1186 (4.2.6) – No major air leaks at an air pressure differential of 1.57 psf. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s).		
	AAMA 501.1/ASTM E1105 – No systemic leaks and all isolated leaks resolved within 3 months post occupancy.		

END OF SECTION

DIVISION 03

CONCRETE

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formwork for cast-in place concrete, with shoring, bracing and anchorage.
- B. Openings for other work.
- C. Form accessories.
- D. Form stripping.

1.2 RELATED REQUIREMENTS

- A. Section 017419 - Construction Waste Management and Disposal
- B. Section 018113 - Sustainable Design Requirements
- C. Section 032000 - Concrete Reinforcing.
- D. Section 033000 - Cast-in-Place Concrete.
- E. Section 051200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
- F. Section 053100 - Steel Decking: Placement of steel anchors in composite decking.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Specifications for Structural Concrete.
 - 3. ACI 303R – Guide to Cast-in-Place Architectural Concrete for Buildings.
 - 4. ACI 318 - Building Code Requirements for Structural Concrete.
 - 5. ACI 347R - Guide to Formwork for Concrete.
 - 6. ASME A17.1 - Safety Code for Elevators and Escalators.
 - 7. ASTM D1621 – Test Method for Compressive Properties of Rigid Cellular Plastics.
 - 8. ASTM D1622 – Standard Test Method for Apparent Density of Rigid Cellular Plastics
 - 9. ASTM D6817/D6817M – Standard Specification for Rigid Cellular Polystyrene Geofoam
 - 10. U.S. Department of Commerce Product Standard:
 - a. PS 1 - Structural Plywood.

11. West Coast Lumber Inspection Bureau (WCLIB):
 - a. Grading and Dressing Rules No. 17
12. United States Green Building Council (USGBC):
 - a. Leadership in Energy and Environmental Design (LEED):
 - b. Green Building Rating System.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on void form materials and installation requirements.
- C. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of joints and ties.
 1. Indicate location of form ties on exposed concrete walls.
 2. Include locations and placement of steel embeds.
 3. Indicate proposed locations of constructions joint.
- D. Shoring and Reshoring:
 1. Submit for records proposed design of shoring, schedule and sequencing of shoring installation and removal, and installing and removing reshoring.
- E. Designer's Qualification Statement.
- F. Design Data: As required by authorities having jurisdiction.
- G. SUSTAINABLE DESIGN SUBMITTALS
 1. Refer to Section 018113 for additional information on LEED submittals.
 2. Comply with Section 017419 Construction Waste Management and Disposal.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design formwork under direct supervision of a Professional Civil or Structural Engineer experienced in design of concrete formwork and licensed in the State in which the Project is located.
- B. Neither the Architect nor the Architect's consultants have been retained to design formwork, nor to determine the means and methods by which such operations are accomplished.
- C. Prior to erecting formwork, coordinate locations of plumbing, mechanical, and electrical blockouts in concrete slabs.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver prefabricated forms and installation instructions in manufacturer's packaging.

- B. Store prefabricated forms off ground in ventilated and protected manner to prevent deterioration from moisture.
- C. Protect plastic foam products from damage and exposure to sunlight.

PART 2 PRODUCTS

2.1 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete forms that complies with design with respect to shape, lines, and dimensions.
- C. Limit deflections to 1/8" between supports after placement of concrete.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.
- E. Formwork design shall comply with ACI 347R, ACI 301, and ACI 318.
 - 1. Design shall be based on calculations prepared by a licensed engineer in California.
- F. Erect formwork in a manner that will ensure the safety of construction personnel and the public.

2.2 WOOD FORM MATERIALS

- A. Plywood: PS 1, Grade B-B, Class I.
 - 1. Douglas Fir species; solid one side grade; sound undamaged sheets with clean, true edges.
- B. Lumber: Douglas species; structural grade; with grade stamp clearly visible.

2.3 METAL FORM MATERIALS

- A. Metal: Min 16 ga sheet steel, tight fitting, and stiffened to support weight of concrete such that tolerances are maintained.
- B. Metal Deck Forms: Metal deck as specified in Contract Drawings.

2.4 FORMWORK ACCESSORIES

- A. Form Ties: Removable or snap-off type, galvanized metal or glass-fiber-reinforced plastic, fixed length, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.
 - 1. Ties should leave no corrodible metal closer than 1 inch to exposed concrete surface.

2. Ties shall be designed to resist lateral pressure of concrete on forms and prevent spalling of concrete on removal.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 1. Composition: Colorless reactive, mineral oil-based, soy-based, or vegetable-oil based compound.
 2. VOC Content: In compliance with applicable local, State, and federal regulations.
 3. Products:
 - a. SpecChem, LLC; Bio Strip WB (water-based): www.specchemllc.com/#sle.
 - b. W. R. Meadows, Inc; Duogard: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- C. Dowel Sleeves: Plastic sleeve and nailable plastic base for smooth, round, steel load-transfer dowels.
- D. Filler Strips for Chamfered Corners: Rigid plastic or wood type; size per contract drawings; maximum possible lengths.
- E. Flashing Reglets: Galvanized steel, at least 22 gage, 0.0299 inch thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- G. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in Section 051200.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

- A. Earth Forms may be used if compacted fill or natural soil can be accurately cut and maintained.
- B. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

3.3 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- G. Coordinate this section with other sections of work that require attachment of components to formwork.
- H. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from Architect before proceeding.

3.4 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply non-staining, rust-preventative form oil or other means of protection against rusting to steel forms.
 - 1. Rust-stained steel formwork is not acceptable for use.
- C. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- D. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

- E. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement. Heat seal joints so they are watertight.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- G. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.

3.7 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.
- B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

3.8 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.
- C. Do not reuse formwork without Architect's approval. When approved, do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view. Do not patch formwork.
 - 1. Reused formwork shall meet appearance requirements of new formwork.
 - 2. Reused formwork shall be free of splaying, fraying, delamination or other damage.
 - 3. Follow all requirements as for new formwork.

3.9 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.
- B. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after curing at not less than 50 degrees F for 72 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

- C. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed until concrete has attained 28-day minimum design compressive strength, but in no case less than 21 days for standard reinforced concrete and 7 days for post-tensioned concrete. Determine potential compressive strength of in- place concrete by testing representative field-cured concrete specimens of concrete in question.
- D. Form facing material may be removed 7 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- E. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- F. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.
- G. If accelerated form removal is desired, submit methods to Architect for review. Review by Architect does not alleviate contractor of responsibility for means and methods of construction and protection of structure during construction.
- H. Reshore members as required in section below.

3.10 RESHORING

- A. Shoring and reshoring shall conform to the requirements of ACI 347.
- B. Extend shoring and 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.
- C. Plan and sequence removal of shores and reshore to avoid damage to concrete. Provide adequate reshoring to support construction without excessive stress or deflection.
- D. Shores shall not be removed prior to concrete achieving 28 day strengths.
- E. While reshoring operations are under way, no construction loads shall be permitted on the new construction.

END OF SECTION 031000

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SECTION 032000 - CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.
- C. Reinforcing steel for masonry work.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 031000 - Concrete Forming and Accessories.
- C. Section 033000 - Cast-in-Place Concrete.
- D. Section 042000 - Unit Masonry: Reinforcement for masonry.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. ACI 301 - Specifications for Concrete Construction.
 - 2. ACI 315 – Details and Detailing of Concrete Reinforcement.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
 - 4. ACI MNL-66 - ACI Detailing Manual.
 - 5. ASTM A184/A184M - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 6. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 7. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 8. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - 9. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 10. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination
 - 11. AWS A5.1 – Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

12. AWS A5.5 – Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
 13. AWS D1.1/D1.1M – Structural Welding Code – Steel.
 14. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars.
 15. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement.
 16. CRSI (DA4) - Manual of Standard Practice.
 17. CRSI (P1) - Placing Reinforcing Bars.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
 - a. Chapter 17 - Structural Tests and Inspections
 - b. Chapter 19 - Concrete
- C. US Army Corps of Engineers (USACE)
1. CW03210: Civil Works Construction Guide Specifications for Steel Bars, Welded Wire Fabric and Accessories for Concrete Reinforcement
- D. United States Green Building Council (USGBC):
1. Leadership in Energy and Environmental Design (LEED):
 2. Green Building Rating System.

1.4 GENERAL

- A. Coordination: Refer to Section 017419 - Construction Waste Management and Disposal regarding procedures for implementing construction waste management requirements.
- B. Coordination: Coordinate Work specified in this Section with other Sections which require placement of embedded products and provision of openings and recesses. If formwork is placed after reinforcing, resulting in insufficient concrete cover over reinforcing, request instructions from Architect (Structural Engineer) before proceeding.
- C. Refer to Section 013000 - Administrative Requirements for RFI requirements.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Reinforcing Shop Drawings:
1. Prepare Shop Drawings in accordance with the applicable requirements of ACI 318 and the CRSI Manual.
 2. Provided scaled, dimensioned reinforcing plans for each floor level indicating size and spacing of reinforcing. Coordinate additional bars with locations of slab openings, penetrations, depressions and steps. Shop drawing shall be coordinated with concrete shop drawings. Ensure penetrations from affected trades for utilities are coordinated.

3. Provide scaled, dimensioned reinforcing elevations for each wall line indicating size and spacing of reinforcing. Coordinate additional bars with locations of openings, penetrations, and recesses. Shop drawing shall be coordinated with concrete shop drawings. Ensure penetrations from affected trades for utilities are coordinated.
 4. Indicate welds in accordance with AWS D1.4/D1.4M and AWS A2.4.
 5. Indicate type of corrosion resistant reinforcing proposed and locations, if applicable.
 6. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.
- C. Test Reports: Submit certified laboratory test reports confirming physical characteristics of materials used in the performance of the work of this Section.
1. Where reinforcing is subject to welding, submit carbon equivalent determination reports in accordance with requirements of Source Quality Control.
- D. Certificates: Submit copies of steel producer's certificates of mill analysis, tensile, and bend tests for reinforcing steel. Transmit copy to installer for welded splices.
- E. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- F. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 318, ACI 301, CRSI and CBC Chapter 19.
- B. Fabricator's Qualifications:
1. When required, show evidence of approval by governmental agencies having jurisdiction.
- C. Welding of reinforcing shall be in conformance with AWS D1.1/D1.1M, AWS D1.4/D1.4M, AWS D1.8/D1.8M and CBC Chapter 19.
- D. Qualification of Welds, Welding operators, and welders:

1. Comply with applicable building code standard. Perform welding procedure qualification, except for prequalified procedures, as required by AWS D1.4/D1.4M, prior to executing any welding of reinforcing steel.
2. Only AWS Certified Welding Inspectors shall be used for tests and qualifications associated with welding of reinforcing steel.
3. Only AWS qualified welders or welding operators shall perform welding of reinforcing steel.
4. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months and in accordance with AWS D1.4/D1.4M.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage. Deliver reinforcing materials bundled and with identifying labels or tags affixed and legible.
 1. Bundle reinforcing, tag with identification, and transport and store so as not to damage any material. Use metal tags indicating size, length and other marking shown on placement drawings. Maintain tags after bundles are broken.
- B. The Inspector and/or Architect reserves the right to observe deliveries, to review bills of lading, and to reject the following:
 1. Reinforcing not accompanied by required mill certificates.
 2. Reinforcing exhibiting rusting or other contamination which might prohibit or inhibit bonding of concrete.
- C. Store materials off ground and under cover.
 1. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
 2. Store welding electrodes in accordance with AWS standards.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 REINFORCEMENT

- A. Provide deformed-type reinforcing conforming to ASTM Standards and material Grades as noted on Structural Contract Drawings.
 1. When welding is indicated, provide reinforcing conforming to the requirements of ASTM A 706, Grade 60.
- B. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.
 1. Form: Flat Sheets.
 2. WWR Style: As indicated on drawings.
- C. Reinforcement Accessories:
 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch, conforming to ASTM A1064/A1064M , Grade 60.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

2.3 MECHANICAL REBAR SPLICING:

- A. Coupler Systems: For use where indicated on drawings, mechanical devices for splicing reinforcing bars; designed to develop minimum 1.25Fy or Fu of the reinforcing bars in both tension and compression, conforming to ACI 318 Type II coupler. Splicing system shall be listed by the International Code Council (ICC) or by the International Association of Plumbing and Mechanical Officials Evaluation Service (IAPMO-ES)
 1. Mechanically Locked Sleeves: Steel sleeves with internal gripping rails and external shear bolts, designed to positively engage the unaltered ends of butted reinforcing bars.
 - a. Products: Dayton Superior "Bar-Lock" System.
 - b. Substitutions: See Section 016000 - Product Requirements.
 2. Dowel Bar Splicers: Integral forged bar end, female-threaded, with nailing flange on one bar and integral matching male threads on the other bar. Provide specially forged bar ends, such that the cut male threads do not diminish the original bar cross section dimension.
 - a. Products: Dayton Superior; "DBDI" System.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.4 FABRICATION

- A. Do not fabricate reinforcing until shop drawings have been reviewed by Architect.

- B. Fabricate concrete reinforcing in accordance with ACI MNL-66: Detailing Manual, ACI 318, and CRSI Manual of Standard Practice.
- C. In case of fabrication errors, do not rebend or straighten reinforcing in a manner that will injure or weaken the material.
- D. Do not heat reinforcing to facilitate bending.
- E. Welding of reinforcement is permitted only where shown on drawings using ASTM A706 reinforcing. Perform welding in accordance with AWS D1.4/D1.4M.
 - 1. Protect joints from drafts during cooling process. Accelerated cooling is prohibited.
 - 2. Do not tack weld reinforcing.
 - 3. Fusion welding is not permitted unless approved by Engineer of Record.
- F. Locate reinforcing splices not indicated on drawings at point of minimum stress.
- G. Comply with tolerances per ACI 117 and CRSI Manual.
- H. Reinforcing with any of the following defects will not be permitted:
 - 1. Lengths, depths, and bends not conforming to the specified fabrication tolerances.
 - 2. Bends or kinks not indicated in the drawings.
 - 3. Reinforcing with reduced cross-section due to excessive rusting or other causes.

2.5 SOURCE QUALITY CONTROL

- A. Tests: Materials for which physical characteristics have been stipulated shall have had such characteristics independently confirmed by laboratory tests employing industry recognized procedures.
- B. Reinforcing to be welded:
 - 1. Submit a copy of the mill test report to the Architect prior to placement of reinforcing steel in concrete members.
 - 2. If mill test reports are not available, perform a chemical analysis of reinforcing representative of the reinforcing to be welded. The carbon equivalent (CE) shall not exceed 0.55.
 - 3. Special inspection is required for welding of steel reinforcing.
- C. Source Quality Control: Testing Laboratory shall test samples of reinforcing, ties, and stirrups from the material at the site or from place of distribution. Each sampling shall include at least two 18-inch long pieces. Perform the following tests according to ASTM A615:

1. Identified Reinforcing: Samples shall be obtained from bundles delivered from the mill, identified by heat number and accompanied by mill analyses and mill test reports. Reinforcing shall be properly tagged with Identification Certificate so as to be readily identified. Then perform one tensile and one bend test for each 10 tons or fraction thereof of each size of reinforcing per CBC Section 1909.2.4. Submit mill reports when samples are selected.
2. Unidentified reinforcing is not permitted.
3. Refer to Section 014500 for general requirements and "Quality Assurance" in Part 1 for specific procedures.

PART 3 EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean reinforcing to remove loose rust and mill scale, earth, and other materials which might reduce or destroy bond with concrete.

3.2 PLACEMENT

- A. General: Comply with the CRSI Manual of Standard Practice and CRSI Placing Reinforcing Bars, 10th edition, for details and methods of placing reinforcing and supports.
 1. Do not displace or damage vapor barrier while placing concrete reinforcing. If damage occurs, repair vapor barrier before placing concrete.
 - a. Provide for movement which equals joint width plus 1/2-inch.
 2. Expansion Joints in Slab-on-grade: Interrupt reinforcing at expansion joints. Provide No. 5 by 24-inch long dowelled joints at 18 inches on centers with one end of dowel set in capped dowel sleeve.
 3. Construction Joints: Allow reinforcing to run through without interruption, unless otherwise noted on Contract Structural Drawings.
- B. Support: Position, support, and secure reinforcing against displacement by formwork, construction or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as required and as indicated on Contract Drawings.
 1. Provide sufficient numbers and sizes of supports to carry reinforcing.
 - a. Do not place reinforcing more than 2 inches beyond the last leg of any continuous reinforcing support.
 - b. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
 - c. Provide additional reinforcing for support where required to support reinforcing shown on Contract Drawings.
 2. Repair and resupport reinforcing which may have moved during concrete placement operations.
- C. Securing in Place:

1. Accurately place reinforcing and wire tie in precise position where reinforcing cross. Bend ends of wire ties away from the forms. Wire tie reinforcing to corners of ties and stirrups.
 2. Support reinforcing according to the current edition of CSRI Recommended Practice for Placing Reinforcing Supports using approved accessories and chairs.
 3. Place precast concrete cubes with embedded wire ties to support reinforcing steel in concrete placed on grade and in footings. Precast concrete cubes are not acceptable in elevated concrete slabs, beams, or concrete filled metal deck.
 4. Use care not to damage vapor barriers where they occur.
 5. Dowel Bar Couplers:
 - a. Attach flanged, internally threaded end of dowel bar coupler to inside of formwork, using nails or screws.
- D. Coverage: Place reinforcing to obtain minimum coverages for concrete protection in accordance with ACI 318 Chapter 20.5.1.3, or as indicated on Contract Structural Drawings. Securely tie reinforcing and related supports together with tie wire to hold reinforcing accurately in position during concrete placement operations. Place wire ties so that twisted ends are directly away from exposed concrete surfaces.
- E. Clearance Between Reinforcing: Per ACI 318 and as indicated on Contract Drawings.
- F. Splicing:
1. Provide standard reinforcing splices by lapping ends and tying securely with tie wire. Comply with details indicated on Contract Structural Drawings.
 - a. Unless noted otherwise on Contract Drawings, comply with requirements of ACI 318 for minimum lap of Class B spliced reinforcing, including ACI 318 as amended by CBC.
 2. Provide 1-1/2-inch minimum clearance between sets of splices. Stagger horizontal reinforcing so that adjacent splices are greater than 4 feet apart, unless noted otherwise on Structural Contract Drawings.
 3. Field Welding: Comply with the requirements of AWS D1.4 where field welding is required. Prior to field welding, determine the weldability of reinforcing in accordance with section "Source Quality Control" in Part 2. Only steel conforming to the chemical requirements of AWS D1.4 may be welded.
 4. Splices: Do not splice reinforcing at the points of maximum stress except where indicated. Lap splices as shown or required to develop the full strength of reinforcing. Stagger splices in horizontal wall reinforcing at least 24" longitudinally in alternate reinforcing and opposite faces.
 5. Mechanical Couplers:
 - a. Mechanically Locked Sleeves:
 - 1) During installation, ensure no damage or misalignment occurs to gripping rails; discard sleeve if damage occurs.
 - 2) Insert first reinforcing bar completely, until it contacts internal divider.
 - 3) Holding bar in position, hand-tighten all bolts.

- 4) Repeat above procedure for second bar.
- 5) In random, alternating order, tighten all bolts to 50% of the specified torque.
- 6) In random, alternating order, tighten all bolts to 75% of the specified torque
- 7) In random, alternating order, drive each bolt until head shears off.
- b. Dowel Bar Couplers:
 - 1) Splice open end of dowel bar to internal reinforcing steel.
 - 2) After concrete has set up, thread externally threaded dowel bar into internally threaded dowel bar; hand tighten.
 - 3) Then, attempt to rotate coupler further 1/4 turn by hand-tightening.
 - 4) Splice open end of dowel bar to internal reinforcing steel.
- G. Wire Fabric: Install welded wire fabric in longest lengths practicable. Lap adjoining pieces at least 12 inches minimum, and lace splices with tie wire. Offset end laps in adjacent widths to prevent continuous laps.
 1. Extend fabric to within 1 inch of edge at slabs.
- H. Slab on Grade Reinforcing: Do not displace or damage vapor retarder at slab on grade.
- I. Dowels: Secure tie dowels in place before depositing concrete. Provide No. 3 reinforcing for securing dowels where no other reinforcing is provided
- J. Maintaining Reinforcing in Position: Provide adequate means to ensure that reinforcing position and spacing is maintained during placement of concrete.
- K. Adjustment and Inspection: Do not bend or straighten reinforcing in a manner injurious to material. Do not use reinforcing with kinks or bends not shown on Drawings and reviewed shop drawings or reinforcing with reduced cross-section due to corrosion or other cause.
- L. Tolerances: Placement tolerances shall conform to CRSI Manual of Standard Practice and ACI 117.

3.3 MASONRY REINFORCING

- A. Refer to section 042000 - Unit Masonry for installation of masonry reinforcing.
- B. Splice reinforcing in masonry with laps as indicated on Contract Drawings.
- C. Position vertical reinforcing in masonry walls and tie in position top and bottom, and at intervals not exceeding 192 bar diameters, unless noted otherwise on the Contract Drawings.
- D. Provide dowels between footings and walls of the same grade, size, and spacing as vertical wall reinforcing, unless noted otherwise on the Contract Drawings.

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 014000 - Quality Requirements, will inspect installed reinforcement for conformance to contract documents before concrete placement.
- B. Inspection and Tests of Welds: Provide special inspection of shop and field welding in accordance with CBC Section 1704, 1705, 1903, and Structural Contract Drawings.
 - 1. Tests will be made by testing laboratory for reinforcing welds, as follows:
 - a. Qualification of welders engaged in electric-arc welding of reinforcing.
 - b. Verification of location of reinforcing for accuracy.
 - c. Inspection of reinforcing welds by certified welding inspectors.
 - d. X-ray test of one of the first three arc-welds made by each welder.
 - 2. Tensile tests of sample welds of the largest size reinforcing for each type of welding.
 - 3. When welds are judged to be deficient, provide and pay for such additional X-rays and tests as directed by the Architect. Defective welds shall be repaired, replaced, and retested.
- C. Placing: Provide special inspection as required by CBC 1705.
 - 1. Placement of Grade 60 or higher reinforcing steel for concrete above grade requires special inspection.
 - 2. Schedule inspecting of reinforcing steel for conduit, sleeves, and embedded items to allow for correction, if necessary, before placement of overlying grids on reinforcing steel.

3.5 ADJUSTING

- A. Defective Reinforcing Work: The following shall be considered defective and may be ordered removed and reconstructed at no change in Contract Time or Contract Sum:
 - 1. Reinforcing with kinks or bends not shown on Contract Drawings.
 - 2. Reinforcing injured due to bending or straightening.
 - 3. Reinforcing heated or bent.
 - 4. Reinforcing not placed in accordance with Contract Documents.
 - 5. Reinforcing that is rusty or oily.
 - 6. Reinforcing exposed in surface of concrete

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete building frame members.
- B. Concrete for composite floor construction.
- C. Elevated concrete slabs.
- D. Floors and slabs on grade.
- E. Concrete shear walls, elevator shaft walls, and foundation walls.
- F. Concrete foundations.
- G. Joint devices associated with concrete work.
- H. Site Concrete Elements, including, but not limited to freestanding walls and their foundations, retaining walls and their foundations, light pole bases and their foundations, and flagpole bases and their foundations.
- I. Miscellaneous concrete elements, including equipment pads and equipment pits.
- J. Concrete curing.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 031000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- C. Section 032000 - Concrete Reinforcing.
- D. Section 033510 - Concrete Flatwork Finishing and Curing
- E. Section 079200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.
- F. Section 323353 - Architectural Site Concrete for additional requirements for retaining walls and other site concrete.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
 2. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide.
 3. ACI 211.2 - Standard Practice for Selecting Proportions for Structural Lightweight Concrete.
 4. ACI 301 - Specifications for Concrete Construction.
 5. ACI 302.1R - Guide to Concrete Floor and Slab Construction.
 6. ACI 303R – Guide to Cast-in-Place Architectural Concrete Practice
 7. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 8. ACI 305R - Guide to Hot Weather Concreting.
 9. ACI 306R - Guide to Cold Weather Concreting.
 10. ACI 308R - Guide to External Curing of Concrete.
 11. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
 12. ACI 347R - Guide to Formwork for Concrete.
 13. ACI 360R – Guide to Design of Slabs-on-Ground
 14. ACI 503.4 – Standard Specification for Repairing Concrete with Epoxy Mortars
 15. ACI MNL-15 – Field Reference Manual
 16. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 17. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
 18. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 19. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 20. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 21. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens).
 22. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
 23. ASTM C150/C150M - Standard Specification for Portland Cement.
 24. ASTM C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 25. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 26. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.
 27. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 28. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 29. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.

30. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
31. ASTM C295/C295M - Standard Guide for Petrographic Examination of Aggregates for Concrete.
32. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
33. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete.
34. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
35. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
36. ASTM C595/C595M - Standard Specification for Blended Hydraulic Cements.
37. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
38. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
39. ASTM C755 - Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation.
40. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete.
41. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars.
42. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
43. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
44. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
45. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
46. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
47. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
48. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
49. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
50. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
51. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
52. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
53. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

54. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
 55. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 56. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
 57. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
 - a. Chapter 11b - Accessibility to Public Buildings, Public Accommodations, Commercial Buildings, and Public Housing:
 - 1) Division 3 - Building Blocks.
 - (a) Section 11B-302 - Floor or Ground Surfaces.
 - 2) Division 4 - Accessible Routes.
 - (a) Section 11B-403 - Walking Surfaces.
 - b. Chapter 17 - Structural Tests and Inspections.
 - c. Chapter 19 - Concrete.
 2. CBSC, Title 24, Part 11 - California Green Building Standards Code (CALGreen), 2022 edition.
- C. US Army Corps of Engineers (USACE)
1. COE CRD-C 513 - Handbook for Concrete and Cement Corps of Engineers Specifications for Rubber Waterstops 1974.
- D. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.
- E. International Association of Plumbing and Mechanical Officials (IAPMO):
1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.
- F. Public Works Standards, Inc. (PWS):
1. Standard Specifications for Public Works Construction, (Greenbook), latest edition with amendments, published by BNi Building News.
- G. United States Green Building Council (USGBC):
1. Leadership in Energy and Environmental Design (LEED):
 2. Green Building Rating System.

1.4 GENERAL

- A. Identify finish flooring manufacturers' concrete slab vapor emission and alkalinity requirements and coordinate concrete slab mixing and installation procedures to achieve desired results. Concrete slab requirements for finish flooring may be more restrictive than general requirements of the Contract Documents, and may require additional materials, means, or methods. Additional materials, means, or methods shall be included as part of the work.
- B. Coordinate method of securing reinforcing and other embedded items in concrete slabs on grade without penetrating vapor barriers.
- C. Verify depth of slab depressions for waterproofing and toppings at walking decks.
- D. Verify depth of slab depression for frame and pan of entrance floor grilles. Coordinate leveling of floor with floor leveling compound and embedment of frame.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions, along with agency approvals (ICC, IAPMO, etc.) where applicable.
- C. Embodied Carbon Footprint Submittals
 - 1. Plant specific Environmental Product Declaration (EPD) for each concrete mixture proposed for the project accompanying each concrete mixture submittal.
 - 2. A calculation showing that the Global Warming Potential (GWP) of all the concrete supplied for the project shall be lower than the GWP target set in Section 2.
- D. Mix Design: Submit proposed concrete mix design for approval.
 - 1. Submit design mix data for each type of concrete and each compressive strength required on the Contract Drawings. Submittal of mix designs shall not relieve Contractor of its responsibility to furnish concrete of proper consistency and specified strengths. Where used for concrete subject to special inspections, submit mix designs to testing laboratory for review and written acceptance.
 - a. Indicate proposed mix design complies with requirements of ACI 301, Section 4 and ACI 318 26.4.3.
 - b. Design mix submittal shall be stamped and signed by a professional engineer licensed in the State of California.
 - c. For each material, including admixtures and water, state water-cement ratio and maximum allowable water content.
 - d. For each material, state manufacturer's name, designation, and source.
 - e. Submit shrinkage and creep factors for each type of aggregate, and each source proposed for use, for acceptance-review.
 - f. For each mix design:

- 1) Pay costs associated with mix design preparation.
 - 2) Consider concrete cover and clear distances between reinforcing bars as indicated on the Contract Drawings in determining the aggregate size for mix designs. This may result in an aggregate size smaller than specified elsewhere in this Specification.
 - 3) Submit a schedule which identifies the locations within the structure where each mix design is proposed for use.
 - 4) Submit project specific 28-day shrinkage test results in accordance with shrinkage test requirements in Part 2 "CONCRETE MIX DESIGN."
 - 5) Indicate proposed mix design complies with fiber reinforcing manufacturer's written recommendations.
- E. Shop Drawings. Concrete shop drawings shall be coordinated with shop drawings requirements for reinforcement and formwork. Submit the following items for review:
1. Layout drawings showing locations of slab-on-grade joints.
 2. Scaled, dimensioned plans for each floor level indicating size and location of slab openings, penetrations, depressions, and steps. Shop drawing shall be coordinated with reinforcing shop drawings. Ensure penetrations from affected trades for utilities are coordinated.
 - a. Provided review stamp, with signature and date, of each trade proposed to work within the opening or penetration.
 3. Proposed Construction Joints.
 4. Scaled, dimensioned concrete elevations for each wall line indicating size and location of openings, penetrations, and recesses. Shop drawing shall be coordinated with reinforcing shop drawings. Ensure penetrations from affected trades for utilities are coordinated.
 - a. Provided review stamp, with signature and date, of each trade proposed to work within the opening or penetration.
- F. Concrete Placement Schedule: Submit the proposed concrete placement schedule to the Architect for review prior to start of concrete placement.
- G. Samples:
1. Pigment Color Selection: Submit manufacturer's complete sample chip set, including pigment number and required dosage rate for each color.
 2. Submit samples of underslab vapor retarder to be used.
 3. Submit two, 12 inch long samples of waterstops and construction joint devices.
 4. Aggregate proposed for exposed finish, indicating color, texture, and size, for acceptance-review. Submit not less than 1 pound of aggregate.
- H. Test Reports: Submit report for each test or series of tests specified.

1. Submit certified laboratory test reports to Architect and, when applicable, the Building Department, confirming physical characteristics of materials used.
 2. Shrinkage and petrographic tests on concrete with the proposed aggregate.
- I. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Aggregates and sand.
 3. Admixtures.
 4. Fiber reinforcement.
 5. Curing compounds.
 6. Floor and slab treatments.
 7. Bonding agents.
 8. Adhesives.
 9. Vapor retarders.
 10. Semi-rigid joint filler.
 11. Joint-filler strips.
 12. Repair materials.
- J. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.
- K. Project Record Documents:
1. Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
 2. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
 3. Concrete Placement: Date and time of each placement as provided in the placement schedule. Include start and end times, temperatures, humidities, and wind velocities.
 4. Test Cylinders: Cross-reference to placement record entries

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with CBC Chapter 19.

1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
- B. Perform work of this section in accordance with ACI 301 and ACI 318.
 1. Maintain one copy of each document on site.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.
- E. Installer Qualifications: A qualified installer who employs on the Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- F. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 1. Manufacturer shall be certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities." The certificate shall indicate that the plant has automatic batching and recording capabilities such that requirements of CBC 1705.3.3.1 are met.
- G. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 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.
- H. 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.
- I. Pre-installation Conference: Conduct conference at Project site.
 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.

2. As applicable to the Work, 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.

J. Mock-up

1. Construct and erect mock-up panel for architectural concrete surfaces indicated to receive special treatment or finish as result of formwork.
 - a. Panel Size: Sufficient to illustrate full range of treatment.
2. Accepted mock-up panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
3. Mock-up may not remain as part of the Work.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- C. Warrant concrete floor sealer to be free from manufacturing defects for a period of 15 years. Applications completed by an approved installer in accordance with published technical data will be warranted for the suppression and control of water vapor emission, alkalinity, and relative humidity from concrete during the warranty period.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of ASTM C595/C595M for packaging and marking for cement delivery.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria
1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria
1. VOC content criteria
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting
 3. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - a. Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - b. Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 4. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 GENERAL

- A. Regulations: Refer to Section 014533 regarding compliance with applicable codes and regulations.
- B. Comply with ACI 301 and ACI 318 for interpreting design requirements of reinforced concrete.
 - 1. Contractor shall keep a copy of ACI Field Reference Manual MNL-15(16) in the field office.
- C. Comply with, regulations of the air quality management district in force at the time of the performance of the work of this Section regarding sealers and curing compounds.
- D. Finish concrete surfaces shall be stable, firm, and in compliance with CBC Section 11B-403 requirements for slip resistance.
 - 1. Concrete paving shall have a minimum slip resistance coefficient of friction of 0.6 as tested in accordance with ASTM D2047.
 - 2. Refer to Part 3 for non-slip finish procedures at exterior concrete platforms, steps, and ramps.
- E. Sloping Floors:
- F. The running slope of walking surfaces shall not be steeper than 1:20.
 - 1. The cross slope of walking surfaces shall not be steeper than 1:48.
 - 2. At plazas where there is no dominant direction of travel, and at turns, slope shall not exceed 1:48 in any direction.

2.3 FORMWORK

- A. Comply with requirements of Section 031000.

2.4 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 032000.

2.5 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150/C150M, type as indicated on drawings.
 - 1. Acquire cement for entire project from same source.
 - 2. Color: Standard Gray UNO.
- B. Cement: ASTM C595/C595M, Type MS – Blended Hydraulic Cement
 - 1. Cement used in contact with soil shall be Type HS – Sulfate Resistant.
- C. Normal Weight Aggregates: ASTM C33/C33M and CBC 1909.2.1.

1. Aggregate shall be nonreactive as determined by one of the methods in ASTM C33/C33M Appendix XI: Methods for Evaluating Potential for Deleterious Expansion Due to Alkali Reactivity of an Aggregate.
 2. Fine Aggregate: Washed natural sand consisting of hard particles, containing not more than the maximum limits of deleterious material allowed by Table 1 of ASTM C33/C33M.
 - a. Fineness modulus shall be in the range of 2.90 to 3.10.
 3. Coarse Aggregate, Structural Concrete:
 - a. Clean washed gravel or sound crushed rock, containing not more than 5 percent flat, thin, elongated, or laminated material, and containing not more than the maximum limits of deleterious material allowed by Table 3 of ASTM C33/C33M for moderate weathering regions.
 - 1) Grade 1-inch aggregate from No. 100 sieve to 1 inch.
 - 2) Grade 1-1/2-inch aggregate from No. 100 sieve to 1-1/2 inches.
 - b. Maximum Size: As indicated on drawings and as noted below.
 - 1) Aggregate shall be no larger than:
 - (a) 3/4 of the clear space between reinforcing bars or between reinforcing bars and forms
 - (b) 1/5 of the narrowest dimension between sides of forms
 - (c) 1/3 of the depth of slab.
 - 2) 3/8" aggregate may be utilized at areas of congestion only when submitted for review, indicating specifically where intended use will be, and approved by the architect.
 - 3) Pea Gravel shall not be used.
 4. Acquire aggregates for entire project from same source.
- D. Lightweight Aggregate: ASTM C330/C330M.
1. Provide lightweight aggregates having a loss of not more than 8 percent when tested by sodium sulfate solution and a loss of not more than 10 percent when tested by magnesium sulfate solution in accordance with ASTM C 88
 2. Maximum Size: 3/4 in or as noted below.
 - a. Aggregate shall be no larger than:
 - 1) 3/4 of the clear space between reinforcing bars or between reinforcing bars and forms
 - 2) 1/5 of the narrowest dimension between sides of forms
 - 3) 1/3 of the depth of slab.
- E. Fly Ash: ASTM C618, Class C or F.
- F. Slag Cement: ASTM C989/C989M
- G. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.

H. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.

I. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.6 ADMIXTURES

A. General:

1. Admixtures and additives shall be reviewed by architect prior to use.
2. Admixtures and additives shall be incorporated and tested in accepted combinations and mixes
3. Admixtures containing chlorides will not be permitted.

B. Air Entrainment Admixture: ASTM C260/C260M.

C. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

1. Manufacturers:
 - a. Euclid Chemical Company; PLASTOL 6420: www.euclidchemical.com/#sle.
 - b. Master Builders Solutions; MasterRheobuild 1000: www.master-builders-solutions.com/en-us
 - c. Substitutions: See Section 016000 - Product Requirements.

D. Water Reducing Admixture: ASTM C494/C494M Type A.

1. Water reduction: Not less than 5%.
2. Increase in compressive strength: Not less than 10% at 28 days.
3. Dry Shrinkage: Less than concrete without admixture at 21 days.
4. Manufacturers:
 - a. Euclid Chemical Company; EUCON NW: www.euclidchemical.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

E. Shrinkage Reducing Admixture:

1. ASTM C494/C494M, Type S.
2. Manufacturers:
 - a. Euclid Chemical Company; Eucon SRA Floor: www.euclidchemical.com/#sle.
 - b. Euclid Chemical Company; Eucon SRA-XT: www.euclidchemical.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

F. Plasticizer: ASTM C494/C494M , Type F

2.7 ACCESSORY MATERIALS

A. Underslab Vapor Retarder: Min 15 mils thick, reinforced high density polyethylene sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Water Vapor Permeance: 0.02 Perms maximum, in accordance with ASTM E154/E154M Section 7.
 2. Puncture Resistance: 2200 grams minimum, in accordance with ASTM D1709 Method B.
 3. Tensile Strength: 45 lbf/in minimum, in accordance with ASTM E154/E154M Section 9, Method ASTM D882.
 4. Installation: Comply with ASTM E1643.
 5. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 6. Manufacturers: Comply with ASTM C755
 - a. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com/#sle.
 - b. Stego Industries, LLC: www.stegoindustries.com/#sle.
 - c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Subslab Waterproofing (At Floor Slabs Subject to Minor Hydraulic Moisture Pressures): Vapor barrier under slab on grade with hydraulic moisture pressures or wet soils.
1. Reinforced high density polyethylene (HDPE), mylar geomembrane, or 1/8-inch thick pre-molded membrane having the following minimum properties:
 - a. Water Vapor Permeance: 0.005 Perms maximum, in accordance with ASTM E96/E96M.
 - b. Water Vapor Barrier Classification: Class A, in accordance with ASTM E1745.
 - c. Puncture Resistance: 2400 grams minimum, in accordance with ASTM D1709 Method B.
 - d. Tensile Strength: 70 lbf/in minimum, in accordance with ASTM E154/E154M Section 9, Method ASTM D882.
 2. Accessory Products: Provide vapor proofing mastic, pipe boots, and related accessory products recommended by manufacturer of vapor retarder.
 3. Manufacturers: Comply with ASTM C755.
 - a. Alumiseal Corporation; Alumiseal Zero Perm Vapor Barrier.
 - b. Reef Industries; Griffolyn VAPORguard.
 - c. Stego Industries, LLC; Stego Wrap 15-Mil Class A Vapor Barrier.
 - d. Substitutions: See Section 016000 - Product Requirements
 4. Seam Tape:
 - a. High density reinforced polyethylene vapor retarding seam tape with pressure sensitive adhesive as recommended by manufacturer of vapor retarder/barrier. Minimum 4 inches in width and of a contrasting color.
 5. Non-Shrink Cementitious Grout:
 - a. Non-Shrink Grout: Prepackaged, non-metallic, non-gaseous, aggregate grout complying with ASTM C1107/C1107M. Contractor shall select type for each special application as recommended by manufacturer.
 - b. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: As indicated on the Contract Drawings.

- c. Flowable Products:
 - 1) Euclid Chemical Company; NS GROUT: www.euclidchemical.com/#sle.
 - 2) Five Star Products, Inc; Five Star Fluid Grout 100:
www.fivestarproducts.com/#sle.
 - 3) The QUIKRETE Companies; QUIKRETE® Exterior Use Anchoring Cement:
www.quikrete.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
- d. Low-Slump, Dry Pack Products:
 - 1) Euclid Chemical Company; DRY PACK GROUT:
www.euclidchemical.com/#sle.
 - 2) Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
 - 3) The QUIKRETE Companies; QUIKRETE® FastSet™ Non-Shrink Grout:
www.quikrete.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
- 6. Non-Shrink Epoxy Grout: Moisture-insensitive, two-part; consisting of epoxy resin, non-metallic aggregate, and activator.
 - a. Minimum Compressive Strength at 7 days, ASTM C579: 12,000 pounds per square inch.
 - b. Manufacturers:
 - 1) Euclid Chemical Company; E3-DEEP POUR: www.euclidchemical.com/#sle.
 - 2) Five Star Products, Inc; Five Star DP Epoxy Grout:
www.fivestarproducts.com/#sle.
 - 3) Five Star Products, Inc; Five Star HP Epoxy Grout:
www.fivestarproducts.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
- 7. Patching Mortar:
 - a. Provide Polymer modified portland cement mortar. Compressive strength shall equal or exceed compressive strength of substrate concrete.
 - b. Mortars shall conform to ASTM C928.
 - c. Manufacturers:
 - 1) Horizontal Application:
 - (a) Durapatch Industrial, manufactured by L&M Construction Chemicals.
 - (b) Embeco R310, manufactured by BASF Admixture Systems.
 - (c) ProSpec Vinyl Concrete Patch, as manufactured by Bonsal American.
 - 2) Vertical and Overhead application: equal to:
 - (a) Durapatch VOH, manufactured by L&M Construction Chemicals.
 - (b) Emaco R350, manufactured by BASF Admixture Systems.

- (c) ProSpec Vertical Leveling Mortar, as manufactured by Bonsal American.
8. Floor Leveling Compound: Two-part acrylic polymer latex concrete with compressive strength as tested by ASTM C109/C109M equal or greater than substrate concrete compressive strength.
 - a. Manufacturers:
 - 1) Ardex; K-15.
 - 2) L&M Construction Chemicals; Levelex.
 - 3) Maxxon Corporation; Level-Right Plus.
 - 4) Substitutions: See Section 016000 - Product Requirements
 9. Floor Patching Materials:
 - a. Patching Materials shall match or exceed compressive strength of the substrate concrete.
 - 1) Interstate Epoxy Patching Compound.
 - 2) Sakrete Fast Setting Cement Patcher.
 - 3) ProSpec Floor Patch Pro, manufactured by Bonsal American.
 10. Skim Coat: Blended compound of portland cement, graded silica aggregates, and special chemical additives formulated for bonding, smoothing, rubbing, and thin coating concrete surfaces.
 - a. Pavcrete manufactured by Lyons Manufacturing or Rapid Set WunderFixx manufactured by CTC Cement.
 - b. Bonding Agent: Manufacturer's Type II acrylic bonding agent, when applicable. Do not use PVA Type I bonding agents.
 - c. Pigment: SGS ColorFlo Liquid iron oxide color pigments, as manufactured by Solomon Colors, or equal, in accordance with ASTM C 979.
 - d. Admixture: Chromix-L manufactured by L.M. Scofield Products, or equal product manufactured by Davis Colors.
 11. Isolation Joint Sealant: Provide polyurethane type compatible with fiber joint filler.

2.8 BONDING AND JOINTING PRODUCTS

- A. Chemical Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II. Agent shall be freeze-thaw resistant and suitable for brush or spray application.
 1. Manufacturers:
 - a. Euclid Chemical Company; AKKRO-7T: www.euclidchemical.com/#sle.
 - b. Larsen Products Corp.; Weldcrete.
 - c. SpecChem, LLC; Strong Bond Acrylic Bonder: www.specchemllc.com/#sle.
 - d. W. R. Meadows, Inc; ACRY-LOK-: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Waterstops: Rubber, complying with COE CRD-C 513.
 1. Configuration: As indicated on drawings.

- 2. Size: As indicated on drawings.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
- D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches on center; ribbed steel stakes for setting.

2.9 CURING AND SEALING MATERIALS

- A. Floor Liquid Curing Compound Type FCC: For use on concrete slabs that will be exposed with separately applied floor sealer finish, or on slabs that will be covered by breathable floor coverings or mortar beds.
 - 1. Compound shall be a water-based non-staining dissipating, translucent resin, conforming to ASTM C309, Type 1, Class B.
 - a. Sodium silicate compounds will not be permitted.
 - 2. Product shall be compatible with subsequently applied toppings (sealers, hardeners, finishes, or coverings).
 - 3. Manufacturers:
 - a. Euclid Chemical Co.; Kurex Vox.
 - b. L&M Construction Chemicals; L&M Cure R.
 - c. Sonneborn Building Products; Sonosil.
 - d. W.R. Meadows; Sealtight 1100 Clear.
 - e. Substitutions: See Section 016000 - Product Requirements
- B. Curing Barriers:
 - 1. Waterproof Curing Paper: Conform to ASTM C171, non-staining reinforced type.
 - a. Manufacturer:
 - 1) Fortifiber Corporation; Orange Label Sisalkraft.
 - 2. Reinforced Curing Barriers: Transguard 4000 manufactured by Reef Industries or equal.
- C. Floor Remedial Vapor Emission and Alkalinity Control Sealer Type FCS: For remedial use on concrete slabs on grade that do not meet manufacturer's specific moisture emission and alkalinity limits for non-breathable floor finishes.
 - 1. Manufacturers:
 - a. Sinak Corporation; Sinak VC5: www.sinak.com.
 - b. Bonsal American; ProSpec Moisture Guard Max.
 - c. Synthetics International; Synthetic30 two-component liquid-applied, waterborne polymer-based ultra-low viscosity clear sealer. www.syntheticsintl.com.
 - d. Substitutions: See Section 016000 - Product Requirements
- D. Floor Sealer Finish Type FSF: For general use at exposed concrete slab areas for appearance.

1. Design is based on the use of high solids, minimum 25% non-yellowing water-based acrylic cure/sealer conforming to ASTM C309, Type 1, Class B and ASTM C1315, Type 1, Grade B, low VOC compliant meeting all local air quality regulations.
 2. Product shall be in compliance with volatile organic compounds (VOC) content limits required by air quality management district at the time of performance of the work.
 3. At Exposed Concrete Surfaces at Garage Areas:
 - a. Compound shall be a water-based non-staining dissipating, translucent resin, conforming to ASTM C309, Type 1, Class B.
 4. Sodium silicate compounds will not be permitted.
 5. Manufacturers:
 - a. Euclid Chemical Co.; Euclid Aqua Cure VOX Super.
 - b. L&M Construction Chemicals; Dress & Seal WB30.
 - c. W.R. Meadows; Vocomp 25.
 - d. Sinak Corporation; HLQ-125.
 - e. Substitutions: See Section 016000 - Product Requirements
- E. Wall Sealer and Water Repellent Finish Type WSR: For general use at exposed concrete wall surfaces in Restrooms for code compliance.
1. Design is based on the use of a modified neat silane repellent system offering invisible protection and low volatility combined with water and oil repellency on concrete substrates to prevent staining by waterborne and oily substance.
 2. Product shall be in compliance with volatile organic compounds (VOC) content limits required by air quality management district at the time of performance of the work.
 3. Manufacturers:
 - a. Miracle Sealants Co.; 511 Impregnator.
 - b. Prosoco, Inc.; Stand Off SLX100 Water & Oil Repellent.
 - c. Substitutions: See Section 016000 - Product Requirements.

2.10 CONCRETE MIX DESIGN

- A. Global Warming Potential Reduction for embodied carbon footprint: Provide embodied carbon footprint reduction for concrete by 25%.
- B. Mix design shall be stamped and signed by a professional engineer licensed in the State of California.
- C. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- D. Proportioning Structural Lightweight Concrete: Comply with ACI 211.2 recommendations.
- E. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.

- F. Concrete Compressive Strengths: Provide compressive strengths as noted on drawings, when tested in accordance with ASTM C39/C39M at 28 days.
 - 1. Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 - a. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- G. Fly Ash or other pozzolans Content: Maximum 25 percent of cementitious materials by weight.
- H. Total of fly ash or natural pozzolans and silica fume: Maximum 35 percent by weight.
- I. Total of fly ash or natural pozzolans slag cement and silica fume: Maximum 50 percent by weight.
- J. Water-Cementitious Material Ratio: As indicated on the Contract Drawings
 - 1. Slabs-on-Grade: Water to cement content shall not exceed a ratio of 0.42 upon delivery at site.
 - 2. Other Concrete Not in Contact with Soils: Water to cement content shall not exceed a ratio of 0.45 upon delivery to site.
- K. Maximum Slump: As indicated on the Contract Drawings
- L. Accurately control the proportions, water content, and air content. Use weighing equipment accurate to within 1 percent for cement and 2 percent for aggregates, and adjustable for varying aggregate moisture content. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
 - 1. Proportion concrete by weight of loose, dry material.
 - 2. Fine aggregate volume shall be at least 35 percent of the sum of the separate fine and coarse aggregate volumes.
- M. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs and testing. Where admixture is proposed for use by concrete supplier, conform to types accepted by Architect in writing.
 - 1. Proposed admixtures shall be as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- N. Fiber Reinforcement: Add to mix at rate indicated on drawings and in accordance to manufacturer's instructions. Provide uniform and complete distribution based on manufacturer's recommendations.
- O. Tests for Concrete Materials at Batch Plant: Utilizing batch plant test records, perform the following tests in accordance with provisions of the building code:
 - 1. Cement: Sample and test cement, or provide mill test reports, as accepted, certifying that the cement conforms to the requirements of this Specification.
 - 2. Aggregate:

- a. Sample and test concrete aggregate for grading and soundness before concrete mix designs are established.
 - b. Test aggregate for shrinkage characteristics in accordance with ASTM C157/C157M.
 - c. Conduct petrographic examinations of aggregate proposed for use in accordance with ASTM C295/C295M.
3. Air Content: ASTM C173/C173M, volumetric method or ASTM C231/C231M, pressure method. One test for each set of compressive strength test specimens.
 4. Refer to "Field Quality Control" in Part 3 for testing of actual concrete mix and placement.
- P. Inspection: Accompany each load of materials or concrete with a signed copy of batch plant's certificate stating quantity of each material, design strength, amount of water added at plant, admixtures, departure time and date, and maximum amount of water allowed to be added at site.
- Q. Shrinkage Test:
1. Before placing any concrete, prepare a trial batch of the mix design, using the same aggregates, cement, and admixtures (if any) proposed for use on the project. Prepare at least three specimens for determining the drying shrinkage of the mix design.
 2. The drying shrinkage specimens shall be 4"x4"x11" prisms, made, cured, dried, and measured as specified in ASTM C157/C157M7. Measure and report separately for 7, 14, 21, and 28 days of drying. After 7 days of moist curing. The effective gauge length of the specimens shall be 10 inches.
 3. The average drying shrinkage of the test specimens after 28 days of drying shall not exceed 0.045 percent for footing and grade beams, and 0.035 percent for all other locations. Use adequate amount of shrinkage reducing admixture as required.

2.11 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M and ASTM C94/C94M.
1. For mixer capacity of 1 cu. yd. (0.76 cu. m) 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. (0.76 cu. m), increase mixing time by 60 seconds for each additional 1 cu. yd. (0.76 cu. m).
 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.
 4. Colored Concrete: Add pigments in strict accordance with manufacturer's instructions to achieve consistent color from batch to batch.
 5. Fiber Reinforcement: Batch and mix as recommended by manufacturer for specific project conditions.
- B. Transit Mixers: Comply with ASTM C94/C94M.

1. With each load, provide ticket certifying the materials and quantities as well as compliance with the accepted mix design.
- C. On the transit mix ticket, state the time water was first added to the mix.
 1. At the batch plant, withhold 2-1/2 gallons of water per cubic yard of concrete.
 2. Upon arrival at the job site, as directed by the Testing Laboratory Inspector, add all or part of the withheld water before the concrete is discharged from the mixer.
 3. Mix concrete for not less than 5 minutes after the withheld water has been added, and not less than 1 minute of that time immediately prior to discharge of the batch.
 - a. Drum shall rotate approximately 70 to 100 revolutions at a mixing speed of approximately 6 to 18 rpm.
 - b. After mixing, drum shall rotate at an agitating speed of approximately 2 to 6 rpm.
 - c. Unless otherwise directed, provide 15 minutes total mixing per batch after first addition of water.
 4. Discharge of the concrete shall be completed within 90 minutes after water is introduced into the mix, or before the drum has completed 300 revolutions.
- D. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.
- E. Weather Requirements:
 1. Hot Weather Usage: Adjust mix as required to counteract effects of anticipated or probable hot weather on strength of concrete. Conform to recommendations of ACI 305R regarding admixtures, temperature of mixing water, and delivery times.
 - a. During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation that may impair required strength or serviceability of the member or structure.
 - b. When air temperature is between 85 degrees F. and 90 degrees F, limit mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 degrees F, limit mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to performing work and placing concrete, verify:
 1. Lines, levels, and dimensions before proceeding with work of this section.
 2. Elevations and depressions of floor finishes
 3. Final excavation required for foundations and footings prior to placing concrete.
 4. Locations of proposed and future breathable and nonbreathable floor finishes in advance of placing concrete to determine type of floor sealers to be applied in finishing operations.
 5. Formwork is properly located such that the unshored concrete will maintain specified tolerances after forms are removed.

3.2 PREPARATION

- A. Formwork: Comply with Section 031000 - Concrete Forming and Accessories.
- B. Reinforcing: Comply with Section 032000 - Concrete Reinforcing.
- C. Verify that forms are clean and free of rust before applying release agent.
- D. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning, roughening to exposed aggregate, and applying bonding agent in according to bonding agent manufacturer's instructions.
 - 1. Use latex bonding agent only for non-load-bearing applications.
- F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade over properly prepared subbase per Geotechnical recommendations. Lap joints minimum 6 inches. Tape and seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 1. Place Slab on Grade directly on vapor retarder.
 - 2. Avoid grade staking through vapor retarder.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
 - 1. Pour concrete in accordance with accepted pour schedule and construction joint layout.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 48 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously between predetermined construction joints per ACI and CBC requirements. Where construction joints are located, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- H. Compacting:

1. General: Spade, rod, vibrate, and consolidate concrete in forms. Vibrators shall not be left in any one spot longer than 30 seconds and shall be kept constantly in motion. One vibrator shall be assigned to each location where concrete is being placed and a standby vibrator shall be kept ready at all times. Avoid creating rock pockets, air bubbles, honeycomb, or separation of ingredients.
2. Work concrete thoroughly around reinforcement and embedded items and into corners and angles of forms by spading, rodding, and tamping.
3. Consolidation: Vibrate to consolidate each layer with previously placed layers, completely embedding reinforcing and fixtures, and bringing fine material to surface of slab to produce proper finish.

I. Hot Weather Placing: Comply with recommendations of ACI 305R.

J. Cold Weather Placing: Comply with recommendations of ACI 306R.

3.4 GROUTING

- A. Non-Shrink Grout: Install non-shrink grout per drawing properly beneath bearings of plates, columns, and other structural members using product recommended by manufacturer for specific application and in accordance with printed instructions.
1. Compressive strength of grout shall be tested in accordance with ASTM C109/C109M .

3.5 CONTROL AND CONSTRUCTION JOINTS

- A. Control Joints:
1. Location: As indicated on the Contract Drawings, but not more than 20 feet on centers in both directions at exterior slabs. Limit interior slabs on grade to 400 square foot bays with length to width ratios of 1 to 1.5 maximum.
 - a. Locate on column center lines and at re-entry corners wherever practical.
 - b. Avoid areas receiving tile or paver floor finish.
 - c. Coordinate locations with proposed floor finish joint layout.
 - d. Limit length to width ratios to 1 to 1.25.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; with width and depth as indicated on drawings.
1. Fill saw cuts in interior walkways with control joint filler specified.
- E. Construction Joints:
1. Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:

2. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
3. A mix containing the same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
4. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.

3.6 SEPARATE NON-STRUCTURAL FLOOR TOPPINGS

- A. Prior to placing floor topping, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.
- B. Place required dividers, edge strips, reinforcing, and other items to be cast in.
- C. Non-structural toppings slabs shall be normal-weight concrete, reinforced as noted on the Contract Drawings.
- D. Place concrete floor toppings to required lines and levels.
 1. Place topping in checkerboard panels not to exceed 20 feet in either direction.

3.7 TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS

- A. An independent testing agency, as specified in Section 014000, will inspect finished slabs for compliance with specified tolerances.
- B. Conform to requirements of ACI 117, except as modified by the requirements of these Specifications and CBC.
- C. Formed Surfaces:
 1. Maintain bowing, warping, and dimensional tolerances within the maximum tolerances stated in ACI 117 for Class A surfaces.
 2. Overall Dimension for Height and Width: Plus zero to minus 3/32-inch for surfaces that are 10 feet and over.
 3. Thickness: Plus-or-minus 1/8-inch maximum.
 4. Openings: Accurate to within a tolerance of plus 1/8-inch to minus zero.
 5. Exposed Slab Edges: Free of jogs exceeding 1/8-inch.
- D. Concrete Slabs: Floor finish tolerances shall be measured in accordance with ASTM E1155 and ACI 302.1R the F-Number System (Inch-Pound Units) for the following conditions:

Element	Specified Overall Value		Minimum Local Value	
	FF	FL	FF	FL
Slab-on-Grade:				

Mech and Electrical Rooms, parking structures	20	15	15	10
Carpeted	25	20	17	15
Thinset Tile, Resilient Flooring	35	25	24	17
Wood Flooring	50	35	35	35
Other not indicated	35	25	24	17
Suspended Slabs:				
Mechanical and Electrical Rooms, parking structures	20	15 (SHORED)	N/A	N/A
Carpeted	25	20 (SHORED)		
Thinset Tile, Resilient Flooring	35	25 (SHORED)		
Wood Flooring	50	35 (SHORED)		
Other not indicated	35	25 (SHORED)		

- E. Verify flatness requirements in accordance with Owner's specification requirements prior to installation.
- F. Suspended Slab Levelness: Where FL is not specified (unshored conditions) floors must be level, and the elevation of the top surface shall fall within a 3/4-inch envelope in accordance with ASCC Tolerances for Suspended Concrete Slabs, unless part of a sloping floor or as otherwise noted.
- G. Concrete Door Sills:
- Slabs Under Operable Partitions or Sound-Rated Accordion Doors: 1/8-inch from level along line under partition or door.
 - Slabs Under Roll-up Doors: 1/8-inch from level along line under partition or door.
- H. Levelness tolerances shall be measured within 72 hours after slab concrete placement.
- Tolerances for sloped floors shall not exceed the slopes specified in "REGULATORY REQUIREMENTS" in Part 2.
- I. Owner reserves the right to test floors and concrete members for conformance to ACI 117 by Use of the Dipstick Floor Profiler. Should tolerances not be within the limits specified, the Contractor shall be required to pay the cost of the tests, as well as the repairs required to bring work into compliance.
- J. Corrective Procedures: See "FILLING, LEVELING AND PATCHING."
- Areas requiring corrective work should be identified and submitted to Architect. Re-measure corrected areas by the same process.

3.8 CONCRETE FINISHING

CAST-IN-PLACE CONCRETE

- A. Concrete shall be finished as indicated on drawings and sealed as required by Architect. Where not indicated, finish as noted below.
- B. Formed Concrete
 - 1. Surface Repairs: Repair surface defects, including defective areas and tie holes as recommended in ACI 301 Section 2 or 6.
 - 2. Rough-Formed Finish: Cast concrete texture imparted by form-facing material, not arranged in any specific visual manner. Repair and patch tie holes and defective areas. Rub down or chip off fins and other projections exceeding 1/4-inch in height.
 - a. Apply to concrete surfaces not exposed to public view.
 - 3. Smooth-Formed Finish: 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 defective areas. Completely remove fins and other projections.
 - a. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.
 - b. Apply the following rubbed finish, defined in ACI 301 Section 6, to smooth-formed finished concrete.
 - 1) Grout-cleaned finish.
 - 2) Smooth-rubbed finish.
 - 4. Related 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.
 - 5. Electrostatic Coatings: Install in accordance with manufacturer's printed instructions.
 - 6. Patching and Skim Coating: Refer to "FILLING, LEVELING AND PATCHING."
- C. Flatwork
 - 1. Screeding: Work out irregularities and bring surfaces to true finish grade or elevation. Remove excess water and debris worked to the surface during compaction and screeding.
 - 2. Initial Troweling:
 - a. Do not commence troweling until surface water sheen has disappeared.
 - b. Use wood bullfloats to open top of slab to allow bleed water out.
 - c. Do not use metal floats.
 - d. Do not apply dry cement, sand, or water to surface.
 - e. Slabs to Receive Mortar-bed with Topping or Bonded Finish: Upon completion of pour, and before concrete has hardened, texture surface of slab with stiff broom, or roughen surface.
 - f. Slabs to Receive Crack Isolation Membrane or Mortar-bed with Cleavage Membrane: Finish slabs with typical smooth troweled surface.
 - 3. Final Troweling:
 - a. Interior Slabs: Steel trowel and burnish.

- 1) Do not finish slab until bleed water has evaporated.
- 2) Do not apply water to the concrete during finishing.
- 3) Do not allow rainwater to stand on slab.
- b. Sills and Other Weather Surfaces: Smooth trowel and burnish. Finish external angles uniform and tooled.
- c. Sealer: Where specified, apply in accordance with the requirements of Section 033511.
4. Finish for Interior Stairs:
 - a. Pedestrian, General:
 - 1) Provide medium broom finish.
5. Float Finish:
 - a. After screeding, consolidating, and straightening concrete slabs, do not work surface until ready for floating.
 - b. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats. The application of Portland cement to slab during floating or troweling is prohibited.
 - c. 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 frill low spots. Repeat float passes and straightening until surface is left with a uniform, smooth, granular texture.
 - d. Finish to straightedge tolerance.
 - e. Cut down high areas and fill in low areas.
 - f. After straightening, refloat surface to uniform, smooth, granular texture.
 - g. Locations:
 - 1) Surfaces scheduled for trowel and broom finishes.
 - 2) Surfaces scheduled to receive adhered roofing or waterproofing membrane.
 - 3) Surfaced scheduled to receive thick-set mortar beds on cleavage membrane.
6. Trowel Finish:
 - a. After applying float finish, apply first trowel finish 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.
 - b. Finish to straightedged tolerance.
 - c. Locations:
 - 1) Surfaces scheduled to receive thin-set mortar beds, resilient flooring, carpet, and wood flooring.
 - 2) Exposed surfaces.
 - 3) Surfaces scheduled to receive paint or other thin film finish coating.

D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:

1. Other Surfaces to Be Left Exposed: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.

3.9 SEALING

A. Formed Concrete Surface:

1. Interior Vertical Surfaces: Where indicated on Contract Drawings, treat vertical surfaces of interior exposed formed concrete with specified sealer finish Type WSR.
 - a. Apply protective treatment in saturating applications without atomizing the product. Use enough to thoroughly wet the surface and create a slight rundown below the spray pattern. Apply uniformly. Don't over apply.
 - 1) Provide two applications of protective treatment at exposed concrete toilet room wall locations. Apply the second coat within a few minutes after the first coat has penetrated and appears dry; do not atomize the product during application.
 - b. Brush heavy runs and drips thoroughly into the surface.
 - c. Protect treated surfaces from contact or by water or for 4 hours.
2. Exterior Vertical Surfaces: Where indicated on Contract Drawings, treat vertical surfaces of exterior exposed formed concrete with sealer in accordance with specified sealer finish Type FSF.

B. Flatwork

1. Grind and clean floors prior to sealing.
2. Sealer/Dustproofer:
 - a. Prepare substrates and spray apply curing sealer in accordance with manufacturer's directions and per Section 033510
 - b. Locations:
 - 1) Mechanical rooms, main trash room, electrical rooms, and telephone rooms.
 - 2) Other locations where indicated or scheduled in Contract Drawings.

3.10 CURING

- A. Comply with requirements of ACI 308R and ACI 318. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 1. Normal concrete: Not less than seven days.
- C. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.
- D. Surfaces Not in Contact with Forms:

1. Curing Compound: Cure by completely and uniformly applying liquid curing compound in accordance with manufacturer's printed instructions. Apply at least two coats at right angles to each other.
 - a. Reapply curing membrane at saw cut joints and at exposed edges of slab after removal of forms.
 - b. Omit curing compound and use moisture curing where required to provide floor sealer.
 - c. Omit curing compound where curing/sealing compound specified provides a concurrent curing function and is applied at the time of concrete placement appropriate to such function.
 - d. Slabs and floors to receive adhesive-applied flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
2. Continuous Moisture: Cure by keeping concrete continuously wet for a period of at least 7 days after pouring in accordance with ACI 308R and ACI 318 for curing interior slabs to receive flooring finishes. During periods of high temperature, low humidity, or wind, wet concrete as often as required to keep concrete continuously moist for a period of at least 10 days. Cover with waterproof curing paper or reinforced vapor retarder, maintaining a film of water.
3. Final Curing: Begin after initial curing but before surface is dry.

E. Ambient Conditions:

1. Hot Weather Curing:
2. Conform to recommendations of ACI 305R regarding curing of concrete flatwork in hot weather.

3.11 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed testing agency.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Testing:
 1. Sample fresh concrete in accordance with ASTM C172/C172M, except modified for slump to comply with ASTM C94/C94M.
 2. Slump: Test will be performed in accordance with ASTM C143/C143M. One test will be made for each concrete load at point of discharge and one test for each set of compressive strength test specimens.

3. Concrete Temperature: Test will be taken hourly when air temperature is 40 degrees F or below, and when 80 degrees F or above, and each time a set of compression test specimens is made.
 4. Curing: Cure specimens in accordance with ASTM C31/C31M.
 5. Frequency of Compressive Strength Testing: Test will be made in accordance with ASTM C39/C39M, ACI 318, CBC Chapter 19A, and Table 1705A.3.
 - a. Test one set of four cylinders for each concrete class placed in any one day for each 50 cubic yards or fraction thereof, or for each 2000 square feet of surface area placed. One specimen will be tested at 7 days, two at 28 days, and:
 - 1) When frequency of testing will provide less than five strength tests for a given class of concrete, testing from at least five randomly selected batches, or from each batch if fewer will be conducted.
 - b. If the average of strength tests of all strength tests of a given class of concrete equals or exceeds the specified strength at 28 days, with no individual strength test less than 500 psi below that specified, the strength level of concrete will be considered satisfactory.
 - c. Retain one cylinder for testing at 56 days if 28-day test fails.
- E. Moisture Vapor Emission Testing: After concrete slabs have cured and prior to installation of finish flooring materials, verify that moisture content and alkali content of concrete slabs do not exceed limits acceptable to manufacturer of flooring materials.
1. Testing Equipment: Test methods based on ASTM F2170 using RH meters and testing kits equal to AMT Moisture/Relative Humidity Meter manufactured by American Moisture Test, Inc., or equivalent by Vaprecision Testing Systems may be used at testing agency's option except at concrete floors with exposed or polished finish.
 2. Alkalinity: Concrete pH test using calibrated digital 1-14 wide range pH meter equal to PH100 to determine alkalinity level in accordance with ASTM F710. Paper and pencil type tests are not acceptable.
 3. Calcium Chloride Testing: After building air conditioning has been in operation for at least 15 days, calcium chloride and pH testing kits may be used: Prepackaged test kit of commercial consistency, equipped with a sealed dish of anhydrous calcium chloride, a metering dome with butyl rubber gasket and instructions for implementation. Weigh dishes on site prior to installation. Conform with requirements of ASTM F1869.
- F. Vapor Emission and Alkalinity Testing:
1. Perform vapor emission and alkalinity testing and take appropriate action based on results in relation to finish floor manufacturer's moisture and alkalinity requirements.
- G. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

3.12 FILLING, LEVELING AND PATCHING

- A. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired, or as directed by Architect.
 - 1. High spots shall be honed, or ground with power-driven machines to required tolerances with approval from Architect.
 - 2. Low spots shall be filled with floor leveling compound, installed in accordance with manufacturer's written recommendations.
- B. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.
- C. Patching Exposed Concrete: After flushing with water, pack tie wire, nail, bolt, and core sample holes which will be exposed as soon as possible after form removal. Grout and repair rough pockets, cracks, or honeycomb. If patches are required, chip defective areas to a uniform depth of at least 1 inch with sides at right angles to surface.
 - 1. Match surrounding concrete surfaces in color and texture. Make trial patch to determine color match. Before applying, moisten surrounding concrete and apply specified bonding compound.
 - 2. Smooth Formed Concrete: Grind off ridges, offsets, and other prominent marks of smooth formed concrete while concrete is green and grind smooth. Sack exposed concrete surfaces.
 - a. Painted concrete shall be considered as being exposed.
 - 3. Patch defects deeper than 1/2-inch in panels with specified patching material and methods deemed by the Architect as the appropriate method to correct such defects.
- D. Skim Coating: Where sack and patch is noted on Contract Drawings, apply to architectural formed cast-in-place concrete walls in accordance with manufacturer's instructions.
 - 1. New concrete must be cured 28 days.
 - 2. pH must be verified prior to skim coating application to determine if primer needs to be applied, as required by manufacturer.
 - 3. Clean concrete in accordance with ASTM D4258.
 - 4. Mixing Skim Coat:
 - a. Add to water, adding only enough to make a stiff trowelable consistency like soft putty.
 - b. Add color additive.
 - c. Working Time: Approximately 15 minutes.
 - 5. Apply to walls with trowel in smooth uniform coat in continuous operations to maintain a uniform shade.
 - 6. Patching: Broad deep areas in concrete surface shall be filled with skim coat material in accordance with manufacturer's directions prior to application of skim coat. Where surfaces are shiny smooth, apply manufacturer's Type II bonding agent.

- E. Patching Unexposed Concrete: Ridges, offsets, and other prominent marks need not be ground off, cleaned, or sacked. This requirement applies to concrete areas that will be concealed by other construction.
 - 1. Finish below-grade concrete indicated to receive waterproofing in the same manner as exposed, smooth-formed concrete, except that surfaces need not be sacked.
 - 2. Patch and repair concrete slabs ready to receive future finish materials installed by Owner.

3.13 DEFECTIVE CONCRETE

- A. Strength
 - 1. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
 - 2. If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.
 - 3. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective and shall be evaluated by Architect and replaced or adequately strengthened in a manner acceptable to the Architect.
 - 4. Test Cores: Should required test cylinders fail to show minimum design compressive strength, take test cores at locations coordinated with the Architect.
 - a. If results show compressive strength to be less than design stress, concrete shall be deemed defective and shall be replaced in a manner acceptable to the Architect.
 - b. If results show compressive strength to conform to design stress, grout solid coring holes with grout exceeding design compressive strength and finish to match adjacent surface.
- B. Concrete Work that is not formed as indicated, is not true within tolerances of span, not true to intended alignment, not plumb or level where so intended, not true to intended grades and levels, cracked, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.
- C. Concrete substrates for non-breathable floor finishes that indicate by testing excess quantities of moisture and alkalinity shall require remedial measures, as specified in this Section.
- D. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing, including patching for cores, shall be borne by Contractor when defective concrete is identified.
- E. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.14 CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
- B. Wash and clean flatwork surfaces. Leave free from oil, paint, plaster, form coating, and other foreign substances, ready to receive scheduled finishes.

3.15 PROTECTION

- A. Protect the Work of this section until Substantial Completion.
- B. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 033000

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SECTION 03 35 10 – CONCRETE FLATWORK FINISHING AND CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Finishing flatwork after strike off, including leveling, floating, troweling; and other concrete finishing methods, including finishing tolerance classifications.
2. Evaporation reducers.
3. Curing compounds.
4. Preventative (day-of-pour) MVECS.
5. Floor hardeners.
6. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 54 16 for underlayment; and for definition of the term “underlayment”.
3. Section 09 05 16 for corrective (remedial) MVECS; and for definitions of the terms “substrate”, “penetrant”, “overlay”, “covering”, and “overburden”.
4. Section 09 97 23 for penetrating concrete floor sealer.

1.2 RELATED DOCUMENTS

A. This specification

1. supersedes any leveling, floating, troweling, and other concrete finishing requirements, including finishing tolerances;
2. compliments the requirements of Section 09 05 16 to generally describe concrete slab finishing and surface preparation for finish flooring. Additional slab finish and surface preparation requirements specific to a particular finish flooring are specified within the applicable specification sections.

1.3 ALTERNATES

- ##### A.
- With input from the preventative (day-of-pour) MVECS manufacturer, preventative MVECS specified in this specification section may be considered for certain concrete curing applications in lieu of curing compounds; and possibly in lieu of corrective (remedial) MVECS products specified in Section 09 05 16.

1.4 REFERENCES

A. Abbreviations and Acronyms:

1. ACI: American Concrete Institute.
2. F(f): Floor Flatness.
3. F(l): Floor Levelness.
4. HVFAC: High-Volume Fly Ash Concrete.
5. MLV: Minimum Local Value.
6. MVECS: Moisture Vapor Emission Control System.
7. MVER: Moisture Vapor Emission Rate.
8. pH: Potential of Hydrogen. (measure of acidity or alkalinity)
9. RH: Relative Humidity.
10. SOV: Specified Overall Value.
11. VDR: Vapor Diffusion Retarder.

B. Definitions:

1. Manufacturer: Means the evaporation reducer, curing compound, MVECS, floor hardener, or accessory manufacturer, as the context admits, unless otherwise indicated.
2. Flatwork: Means all concrete work along a horizontal plane, including indoor floors and decks, concrete stairs, and outdoor patios, sidewalks, and driveways. Flatwork excludes vertical structures like walls or bridges.
3. General Concrete Terms:
 - a. Freshly-Mixed Concrete: Means a homogenous mixture of blended hydraulic cement, aggregates, and water, with or without admixtures, fibers, or other cementitious materials.
 - b. Newly-Placed Concrete: Means freshly-mixed concrete that is deposited (placed), distributed (spread), screeded (struck-off), and consolidated (tamped) in the place where it hardens, but not yet floated, troweled, or otherwise finished. (aged up to approximately one hour after placement)
 - c. Newly-Finished Concrete: Means newly-placed concrete, the surface of which has deliberate floating, troweling, and other finishing actions performed during a period promptly after strike off and after bleed water, glaze, or sheen has disappeared and the concrete is hard enough to resist surface damage, but before initial set; and whose surface is damp but not wet. (aged approximately one to 4 hours)
 - d. Cured Concrete: Means newly-finished concrete, the surface of which has had deliberate actions taken between final finishing and the termination of curing to reduce loss of water from the flatwork surface; and control concrete temperature.
 - 1) Initially-Cured Concrete (Beginning Curing): Means newly-finished concrete before initial set when bleed water is evaporating too rapidly to keep the surface wet. (aged approximately one to 4 hours)

- 2) Newly-Cured Concrete (Intermediate Curing): Means newly-finished concrete during a period following initial set, but before final set. (aged approximately 4 to 8 hours)
 - 3) Recently-Cured Concrete (Final Curing): Means newly-finished concrete during a period following final set. (aged approximately 8 hours to 14 days)
 - e. Hardened Concrete: Means recently-cured concrete that has sufficient strength to serve its purpose or resist breaking under stipulated loading (approximately 7 to 28 days or older), and that has not been exposed to weathering or contaminates.
 - f. Newly-Aged Concrete: Means hardened concrete aged more than 28 days whose surfaces have been exposed to weathering, including abrasion, liquid penetration, freeze/thaw cycles, and salts or other contaminates.
 - g. Existing Concrete: Means concrete that was placed, finished, cured, hardened, and weathered prior to the start of the project that is indicated as remaining, and which may also require cleaning, resurfacing, rehabilitation, or strengthening.
4. Concrete Finishing Terms:
- a. Smooth: Means having a continuous even surface free from irregularities, roughness, projections, bumps, points or ridges.
 - b. Surface Defect: Means surface voids, aggregate transparency, color variation, spalling, cracking, offsets, and similar cavities or irregularities.
 - c. Trowel Pattern: Means a flatwork surface feature produced by troweling that is seen but cannot be felt.
 - d. Trowel Mark: Means a flatwork surface defect produced by troweling that is both seen and felt.
5. Concrete Curing Terms:
- a. Water Curing: Means curing flatwork by flooding with water (ponding or immersion), continuously spraying with water, or fog mist-spraying to replace evaporating water. Adding water to the surface does not mean adding water that is worked into the concrete mix, which may increase the surface concrete water-cement ratio and weaken it.
 - b. Wet Covering Curing: Means curing flatwork with coverings, including earth, sand, sawdust, straw, hay, canvas, hessian or jute burlap, or natural cellulose fabric, which are kept continuously wet to replace water evaporating from flatwork.
 - c. Sheet Curing: Means curing flatwork with water retaining coverings, including waterproof paper or plastic film, which prevent water from evaporating from flatwork.
 - d. Curing Compounds: Means curing flatwork with liquid membrane-forming resinous materials that prevent water from evaporating from flatwork. Solutions of silicate salts are chemically reactive in concrete rather than membrane-forming; therefore, they do not meet the definition of a curing compound.

1.5 ADMINISTRATIVE REQUIREMENTS

A. General Coordination:

1. Though certain curing methods may be generally recommended and preferred for curing concrete (to minimize the risk of potential flatwork failures), the Contractor controls the means and methods for flatwork finishing and curing.
 2. Contractor shall perform or arrange and pay costs without reimbursement from the Owner for all remedial work necessary to correct or improve all deficient conditions and all failures directly or indirectly caused by concrete curing means and methods, without limitation, including delays, schedule disruptions, corrections, repairs, and replacement.
 3. Proposed substitution requests and submittals that change the generic chemistry of specified concrete finishing and curing materials are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 4. Specified coverage rates are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.
- B. Concrete Mix Design Coordination: Coordinate concrete finishing methods and curing materials with factors of the approved concrete mix design that affect concrete bleeding, including the presence of water-reducing admixtures, air-entraining agents, and fly ash, especially HVFAC
- C. VDR Coordination:
1. Coordinate finishing methods and curing materials with the selected below-grade VDRs, and with the location of the VDR within each flatwork assembly.
 2. Do not double steel trowel interior flatwork installed over VDRs.
 3. When curing compounds are selected by the Contractor for use in curing concrete, with the assistance of both the VDR and curing compound manufacturers, coordinate the selection of the correct curing compounds to match selected VDRs.
- D. Concrete Finishing Coordination:
1. Coordinate finishing with forecast and actual weather conditions measured at the project site, including factors that affect surface setting such as high wind velocity, low RH, rising air temperature, and exposure to direct sunlight. Where practicable, make arrangements to block wind and shade newly-placed concrete from direct sunlight.
 2. Coordinate concrete finishing with penetrant, overlay, and covering material preparation, application, and installation requirements indicated in other specification sections. Finish concrete in conformance with tolerances and surface finishes required, recommended, or accepted by all penetrant, overlay, and covering material suppliers and manufacturers.
 3. Without limitation, either perform or arrange and pay costs reimbursement from the Owner for performing all remedial work necessary to correct or remove, dispose of,

and replace defective flatwork, the surface finish and tolerances of which do not conform to the penetrant, overlay, and covering manufacturers' surface finish and tolerance requirements.

E. Concrete Curing Coordination:

1. Coordinate flatwork curing to ensure selected curing materials and methods result in flatwork that conforms to the penetrant, overlay, and covering manufacturers' MVER, pH, RH, and warranty requirements.
2. Coordinate finishing with both forecast and actual weather conditions measured at the project site, including factors that affect surface setting such as high wind velocity, low RH, rising air temperature, and exposure to direct sunlight. Block wind and shade newly-placed concrete from direct sunlight.
3. If liquid membrane-forming curing compounds are selected for use in curing concrete flatwork, then with assistance from the VDR, curing compound, and finish flooring manufacturers, coordinate selection of the correct curing compounds with selected VDR and finish flooring materials and flooring installation materials based on current product formulations.
 - a. Verify chemical and adhesive compatibility of selected concrete curing compounds and installed MVECS with selected finish flooring materials and flooring installation materials, including all primers, adhesives, and sealants, based on current product formulations.
 - b. Contractor assumes responsibility for all subsequent flatwork conditions, floor finish issues, and substrate failures brought about or attributable to curing compound use, including MVER failure.
4. Without reimbursement from Owner, perform or arrange and pay costs for performing all remedial work necessary to correct and improve
 - a. defective flatwork, including areas that exceed the MVER, pH, and RH limits required, recommended, or accepted by the penetrant, overlay, and covering manufacturers; and
 - b. penetrant, overlay, and covering failures resulting from selected concrete curing methods; and coordination of, or failure to coordinate, the chemical and adhesive compatibility of selected curing compounds with all subsequent penetrants, overlays, and covering materials, including primers, adhesives, and sealants, and other installation materials.

F. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning VDR installation.
 - a. VDR manufacturer's representative and installer must attend meeting.
 - b. Concrete finishers and the evaporation reducer, curing compound, and MVECS manufacturer's representatives and MVECS installers must attend the meeting.
 - c. Tiling, flooring, and concrete sealer manufacturers' representatives and installers must attend the meeting.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation.

- a. Review, discuss, and complete the National Ready Mixed Concrete Association and American Society of Concrete Contractors publication NRMC/ASCC, *"Checklist for the Concrete Pre-Construction Conference"* during the course of the pre-installation meeting. (available from www.nrcma.org or www.ascconline.org)
 - b. Discuss the use (or not) of maturity testing for this project, including development of the maturity calibration curve. and equipment requirements and sensor placement for measuring in-place concrete maturity.
 - c. Review and discuss specified tolerance standard document, including concrete construction tolerances, tolerance compatibility at interface between concrete and other building systems, and suggested methods for mitigating tolerance conflicts.
 - d. Review and discuss flatwork finishing tolerances, flatness and levelness, curing methods, and floor protection, including all applications and restrictions for each.
 - e. Review and discuss floor testing, failures, causes, prevention, and remedial measures, including responsibilities for repair and remedial work necessary to correct and improve defective or non-conforming flatwork.
 - f. Review and discuss the difference between floor preparation and floor repair, including responsibilities for each.
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed flatwork. Resolve each condition.
 4. Finalize construction schedule.
 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- G. Sequencing:
1. When drilling for RH probes specified in Section 09 05 16 is inadvisable (such as when floor heating elements, water tubing, or other items are installed), provide wet concrete RH meter accessories for installation prior to placing concrete.
 2. Begin concrete finishing operations promptly after strike off, though refrain from troweling until after bleed water, glaze, or sheen has disappeared. (if troweling is begun while bleed water is still visible, surface defects are likely, and delamination is possible)
 3. Both wet coverings saturated with water and sheet curing materials may be used only after the concrete has hardened enough to prevent surface damage, including both marks and patterns. Depending upon environmental conditions at the project site, initial curing may be necessary when utilizing wet covering and sheet curing.
- H. Scheduling:
1. Saw Cutting: Newly-cured concrete contraction joints must be cut during a period within the first one or 2 hours of finishing, or as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw blade, and before final set. (within approximately 24 hours)

2. Minimum Concrete Curing Period: Allow sufficient time in the construction schedule to permit concrete flatwork to cure undisturbed for at least the following time periods, at ambient temperatures above 40 deg. F.
 - a. ASTM C 150 Type I Cement (used when the special properties specified for any other types are not required): At least 7 consecutive days.
 - b. ASTM C 150 Type II Cement (general use; used when moderate sulfate resistance or moderate heat of hydration is required): At least 10 consecutive days.
 - c. ASTM C 150 Type III Cement (high early-strength): At least 3 consecutive days.
 - d. ASTM C 150 Type IV Cement (low heat of hydration) or Type V Cement (high sulfate resistance): At least 14 consecutive days.

1.6 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Test Reports: Submit manufacturer's ASTM Test Method C 156 water retention laboratory test results demonstrating submitted products conform to ASTM C 309 Section 6 requirements water retention properties.
- B. Informational Submittals: Submit the following for information (informal review; responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished concrete sealers.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
 3. Manufacturer's Representative Reports:
 - a. At the beginning of work, request and submit reports confirming concrete is prepared in conformance with manufacturer's instructions and other requirements and recommendations; are acceptable and satisfactory to receive curing compounds; and conform to all requirements necessary to issue specified and other warranties.
 - b. During the work, request and submit reports documenting actions taken by the manufacturer's representative to verify conformance with manufacturer's instructions and other requirements and recommendations.

- c. Upon completion, request and submit reports confirming installed waterproofing conforms to all requirements necessary to issue specified and other warranties.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Curing materials must be obtained only from a manufacturer that sends a representative to the project site before beginning work to verify conditions; and during work to perform manufacturer's field services.
- B. Regulatory Requirements:
 1. Portland cement concrete paving must be stable, firm, and slip resistant and must conform to California Building Code Sections 11B-302 and 11B-403.
- C. Quality Standards:
 1. Tolerance Standard: Comply with ACI publication 117 *"Guide for Tolerance Compatibility in Concrete Construction"* requirements and recommendations for concrete construction tolerances, tolerance compatibility at interface between concrete and other building systems, and suggested methods for mitigating tolerance conflicts.
- D. Qualifications:
 1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing concrete sealers installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
 2. Concrete Finishers: Company or individuals must have at least 5 years' experience finishing and curing concrete for at least 30 previous projects similar to this project in size, material, design, and complexity. Individuals performing flatwork finishing and curing must be ACI-certified Flatwork Technicians and Finishers and current in their certification.
 3. Supervisors: Individuals must have at least 7 years' experience finishing and curing concrete for at least 30 previous projects similar to this project in size, material,

design, and complexity, including at least 2 years' supervisory experience directing and leading concrete finishers. Supervisors must be ACI-certified Flatwork Technicians and Finishers and current in their certification.

4. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in material, design, and complexity.

1.8 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective [coating]s with undamaged new [coating]s that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.9 PROJECT CONDITIONS

- A. Ambient Conditions: Install evaporation reducers and curing compounds only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
 1. Do not install evaporation reducers and curing compounds during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.

2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.

1.10 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- C. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 EVAPORATION REDUCERS (EVAPORATION RETARDANTS)

- A. Description: VOC-compliant water-based polymer liquid that forms a thin continuous film when applied to fresh concrete, which controls the flatwork surface conditions until finishing operations cause the thin film to completely dissipate.
 - 1. Evaporation reducers are not curing compounds. Concrete treated with evaporation reducers must be cured.
 - 2. Evaporation reducers are not surface retarders.
- B. Applications: Used on surfaces of newly-placed concrete to temporarily reduce rapid moisture loss from flatwork due to any of the following conditions and applications.
 - 1. High temperature.
 - 2. Low humidity.
 - 3. High wind.
 - 4. Direct sunlight.
 - 5. Indoor applications heated in winter.
 - 6. Low water-cement ratio concrete applications.
 - 7. Concrete mixes indicated as containing either super plasticizers or silica fume.
- C. Restrictions: Do not apply evaporation reducers during final troweling operations. (slab discoloration may occur)
- D. Products: Provide one of the following, or equal.
 - 1. "EUCOBAR" manufactured by The Euclid Chemical Co.
 - 2. "E-CON" manufactured by L&M Construction Chemicals, Inc.
 - 3. "Sealtight Evapre" manufactured by W.R. Meadows, Inc.

2.3 CURING COMPOUNDS

- A. Description: Liquids containing film-forming polymers used to seal the surface of newly-finished concrete and prevent rapid moisture loss.
- B. Application: When the permitted use of curing compounds is selected to cure flatwork, temporary (chemically dissipating) curing compounds are recommended and preferred.
- C. Restrictions: Liquid membrane-forming curing compounds are not recommended where moisture-sensitive finish flooring is installed. Concrete curing compounds may not be used to cure flatwork indicated as receiving penetrants, overlays, or coverings without prior written acceptance from the manufacturer based on actual in-service conditions.
 - 1. If temporary curing compounds are used to cure flatwork, then mechanical abrasion, including planing and grinding, must be provided before beginning installation of any penetrant or overlay, including substrate preparation, to achieve complete removal of any film left behind that does not dissipate. If mechanical abrasion methods do not adequately remove temporary curing compounds, then shot blasting, bead blasting, and abrasive blasting down to a level below curing compound penetration must be utilized before beginning application of any penetrant, overlay, or covering, including substrate preparation, to achieve complete curing compound removal.
 - 2. If permanent curing compounds are used to cure flatwork, then shot blasting, bead blasting, and abrasive blasting down to a level below curing compound penetration must be utilized before beginning application of any penetrant, overlay, or covering, including substrate preparation, to achieve complete curing compound removal.
- D. Temporary Curing Compounds (Chemically Dissipating Compounds):
 - 1. Description: Resin-based liquid membrane-forming curing compound conforming to ASTM C 309, Type 1-D (clear or translucent with fugitive dye that loses its coloring during proper usage), Class B (resin).
 - 2. Restrictions: Temporary curing compounds must be completely removed before beginning floor covering installation
 - 3. Products: "KUREZ DR-100" manufactured by The Euclid Chemical Co., or equal.
- E. Permanent Curing Compounds (Non-Dissipating Compounds):
 - 1. Description: Water-based curing compound conforming to ASTM C 1315, Type 1 (clear or translucent), Class A (non-yellowing) and must be specially formulated and warrantied for proper concrete curing and chemical and adhesive compatibility with all covering adhesives and materials.
 - 2. Restrictions: Use only where floor coverings are indicated.
 - 3. Products: "FloorBond 710" manufactured by Floor Seal Technology, Inc., or equal.
- F. Silicate-Based Curing Compounds: Curing compounds that contain silicate salts are prohibited. (these are chemically reactive in concrete, not film-forming)

- G. Combination Curing Compounds: Combination curing compounds are prohibited, including cure & seal; cure & harden; cure, seal, & harden; and cure, seal, harden & dustproofing compounds.
- H. Requisite Properties:
 - 1. Water Retention Rate: Maximum water loss may not exceed 0.40 kilograms per square meter in 72 hours, when tested in conformance with ASTM C 156.
 - 2. Maximum VOC Content: Not more than 60 grams per liter.

2.4 PREVENTATIVE (DAY-OF-POUR) MVECS

- A. Description: Resin-based compound conforming to ASTM C 1315 and specially formulated for proper concrete curing; reducing moisture vapor emission levels to a specific and measurable rate; reducing shrinkage cracking; and chemical and adhesive compatibility with all floor covering adhesives and materials.
- B. Application: With input from the preventative MVECS manufacturer, day-of-pour preventative MVECS may be considered for certain curing applications in lieu of curing compounds; and possibly in lieu of corrective (remedial) MVECS products specified in Section 09 05 16.
- C. Restrictions: When substrates receiving day-of-pour preventative MVECS subsequently demonstrate during testing MVER and pH exceeding the limits required, recommended, or accepted by the penetrant, overlay, and covering manufacturers' published limits, preventative MVECS manufacturer must apply to those areas the corrective (remedial) MVECS products specified in Section 09 05 16 at no additional expense to the Contractor or Owner.
- D. Products: "VaporSeal 309" manufactured by Floor Seal Technology, Inc., or equal.
- E. Requisite Properties:
 - 1. Minimum Water Retention Rate: Maximum water loss of not more than 0.40 kilograms per square meter in 72 hours, when tested in conformance with ASTM C 156.
 - 2. Maximum VOC Material Content: Not more than 100 grams per liter.

2.5 FLOOR HARDENERS

- A. Description: Water-based lithium silicate chemical hardening compound that chemically reacts to seal, harden, and densify flatwork surfaces.
- B. Products: Provide one of the following, or equal.
 - 1. "Consolideck LS" manufactured by PROSOCO, Inc.
 - 2. "MirrorCrete" manufactured by Floor Seal Technologies.

2.6 ACCESSORIES

- A. Screed Stakes: Prohibited; screeding systems must not puncture the below grade VDRs.
- B. Wet Concrete RH Meter Accessories:
 - 1. Description: Disposable plastic tubes for measuring humidity in concrete.
 - 2. Manufacturer: Provide accessories manufactured by Vaisala Inc., or equal.
 - 3. Products: Provide all of the following parts for wet concrete installations.
 - a. Plastic Tube Set: Vaisala Part No. 19266HM, or equal.
 - b. Plastic Flange Set: Vaisala Part No. 26529HM, or equal.
 - c. Long Rubber Plug Set: Vaisala Part No. 26530HM, or equal.
- C. Saw Blades:
 - 1. Description: Diamond blades for early-entry dry-cut saws.
 - 2. Products: "Soff-Cut" manufactured by Husqvarna Construction Products, or equal.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify formwork, VDRs, and items penetrating flatwork are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from the Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Substrate Acceptance:
 - 1. Before starting curing compound application, the manufacturer's representative must examine and certify that flatwork surfaces are properly finished in a manner that does not void specified warranties, and satisfactory and ready to receive curing materials.

2. Request and accommodate the manufacturer's representative's presence as required thereafter to review installation progress, review completed work, and issue specified warranties.

3.3 FINISHING

A. General:

1. Comply with ACI 302.1R recommendations for screeding, floating, re-straightening, and finishing flatwork, including the proper use of a highway straightedge where applicable.
2. Finish concrete in conformance with the specified quality standard requirements.
3. Protect concrete from rapid moisture loss before and during finishing operations.
 - a. Apply evaporation reducer as needed prior to beginning finishing operations, and periodically during finishing.
 - b. Do not apply water to the slab surface during finishing operations.
4. Finish flatwork to produce uniform surface appearance throughout the area involved and adjacent areas with the same finish.
5. Compacting and Floating:
 - a. Use continuous screeds spaced or located to produce specified substrate tolerances. Bring substrates to proper level and strike-off with a straightedge.
 - b. Remove excess water and laitance.
 - c. Compact and consolidate to embed coarse aggregates.
 - d. Float and test surfaces with a 10-foot straightedge and eliminate high and low spots.
 - e. Use methods and tools necessary to produce proper finishes and tolerances.
6. Concrete Placed over Metal Decking:
 - a. Use adjustable screeds at all screeded points and adjust to compensate for deck, beam, and girder deflection; and for deflection occurring during concrete placement.
 - b. Do not use steel closures at metal deck edges as screeds.
 - c. Continuously monitor screeds and substrates during concrete placement and finishing and adjust concrete floor thickness as required to obtain level floors conforming to specified tolerances.

B. Rough Finishes

1. Basic Finishing: Screed and bullfloat flatwork surface.
2. Scratch Finishing: Beginning with a basic finish, roughen the flatwork surface with stiff brushes, brooms, or rakes to produce a 1/4-inch surface profile in one direction before final set.
3. Float Finishing:
 - a. Beginning with a basic finish, consolidate flatwork surfaces using power-driven floats; or by hand floating if areas are too small or inaccessible by power-driven floats.
 - b. Re-straighten, cut down high spots, and fill low spots.

- c. Repeat float passes and re-straightening actions until flatwork is left with a uniform, smooth, granular texture.
- C. Textured Finishes:
- 1. Broom Finishing:
 - a. Beginning with a float finish, lightly steel trowel to remove irregularities.
 - b. Roughen flatwork by drawing at least a 24-inch-wide fiber bristle broom (for medium broom finish) or steel bristle broom (for heavy broom finish), across the flatwork surface perpendicular to the main direction of traffic.
 - c. Produce even texture from edge to edge; slightly lap adjacent strokes to produce a uniform pattern.
 - d. Obtain the Architect's approval for proposed texture before final application.
 - 2. Swirl Finishing:
 - a. Beginning with a float finish, continue hand float the flatwork surface using a wood float to produce a continuous swirl patterned surface that is free from porous and rough spots, which are often produced by disturbing particles of coarse aggregate embedded near the surface.
 - b. Obtain the Architect's approval of the proposed texture before final application.
 - c. Finish texture appearance, size, and quality in every area must match approved mockups, as determined by the Architect.
 - d. Due to higher evaporation rates caused by increased porosity of swirl finishes, swirl finishes must be cured in conformance with specified requirements for hot-weather protection during curing regardless of weather conditions. (this may require increased use of evaporation reducers and curing compounds)
 - e. All swirl finished concrete must have specified surface hardener applied after at least 28 days of curing.
- D. Smooth Finishes:
- 1. Light Steel Trowel Finishing (requires at least one pass):
 - a. Beginning with a float finish, consolidate flatwork surface by hand troweling.
 - b. Continue trowel passes and re-straightening actions until flatwork surfaces are free of trowel marks, are uniform in texture and appearance, and fall within specified flatness tolerances.
 - c. Grind smooth all surface defects that might telegraph through applied floor coverings.
 - d. Steel trowel to a hard, dense finish.
 - 2. Normal Steel Trowel Finishing (requires at least 2 passes):
 - a. Beginning with a light trowel finish, continue hand troweling until a ringing sound is produced as the trowel is moved over the surface.
 - b. Continue trowel passes and re-straightening actions until flatwork surfaces are free of trowel marks, are uniform in texture and appearance, and fall within specified surface plane tolerances.
 - c. Grind smooth all surface defects that might telegraph through applied floor coverings.
 - d. Steel trowel to a hard, dense finish.

3. Hard Steel Trowel Finishing (requires at least 3 passes):
 - a. Beginning with a normal trowel finish, continue hand troweling until a ringing sound is produced as the trowel is moved over the surface.
 - b. Continue trowel passes and re-straightening actions until flatwork surfaces are free of trowel marks, are uniform in texture and appearance, and fall within specified surface plane tolerances.
 - c. Grind smooth all surface defects that might telegraph through applied floor coverings.
 - d. Steel trowel to a hard, dense finish.
4. Restrictions:
 - a. Do not hard trowel air entrained concrete.
 - b. Do not hard trowel exterior concrete.
 - c. Do not normal or hard steel trowel interior slabs on grade having an underslab vapor retarder.

3.4 TOLERANCES

- A. General: Finish concrete in conformance with the specified quality tolerance standard requirements. Flatwork must conform to the tolerance classifications indicated below, when measured with 3D laser scanning or Allen Face F-Meter methods.
 1. When flatwork tolerance is measured with a straightedge, flatwork must be measured in conformance with ASTM E 1486 between 16 and 72 hours after final troweling using a 10-foot straightedge placed anywhere on the slab in any direction and allowing it to rest on 2 high spots.
 2. When flatwork is not sloped, floor flatness and levelness must be measured in conformance with ASTM E 1155 between 16 and 72 hours after completion of final troweling.
 - a. Specified flatness values apply to both slabs on grade and elevated slabs.
 - b. Specified levelness values apply only to slabs-on-grade and to elevated slabs when the slab remains supported in its as-cast position and there is no camber present.
 - c. Specified levelness values do not apply to inclined or cambered slabs.
 3. Verify actual substrate tolerance, flatness, and levelness requirements with each selected flooring manufacturer.
- B. Conventional Floor Classifications:
 1. Float Tolerance: Not used.
 2. Straightedge Tolerance:
 - a. Application: Generally recommended as a substrate for self-leveling overlays, polymer overlays, concrete toppings and repairs, broadloom carpet, medium and thick bed tiles with all edges less than 15 inches, penetrating concrete sealer, floors used for utility spaces, and floors usually left exposed.
 - b. Minimum Tolerance: True plane with not more than 1/4-inch gap under a 10-foot straightedge.
 - c. Minimum Flatness: SOV at least F(f) 25, with MLV at least F(f) 17.

- d. Minimum Levelness: SOV at least F(l) 15 with MLV at least F(l) 10.
- C. Traditionally Flat Floor Classifications:
- 1. Moderately Flat Tolerance:
 - a. Application: Generally recommended as a substrate for resilient tile, resilient sheet flooring, tile carpeting, and exposed in service concrete indicated as received a penetrating concrete sealer.
 - b. Minimum Tolerance: True plane with not more than 3/16-inch gap under a 10-foot straightedge.
 - c. Minimum Flatness: SOV at least F(f) 35, with MLV at least F(f) 23.
 - d. Minimum Levelness: SOV at least F(l) 20 with MLV at least F(l) 10.
 - 2. Flat Tolerance:
 - a. Application: Generally recommended as a substrate for epoxy terrazzo.
 - b. Minimum Tolerance: True plane with not more than 1/8-inch in 10 feet variation.
 - c. Minimum Flatness: SOV at least F(f) 52 with MLV at least F(l) 35.
 - d. Minimum Levelness: SOV at least F(l) 20 with MLV at least F(l) 10.
- D. Exceptionally Flat Tolerance Classifications: Not used.

3.5 CURING

- A. General:
- 1. Protect newly-finished concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 requirements for cold-weather protection, and with ACI 305.1 requirements for hot-weather protection during curing.
 - a. Cold Weather Requirements: When flatwork is subjected to freezing temperatures within 24 hours after placement, or when flatwork is subjected to a period of 3 or more successive days within 7 days after placement where average daily outdoor temperature drops below 40 deg. F, flatwork must be protected from freezing. After placing concrete, maintain air temperature adjacent to flatwork to at least 50 deg. F for at least 7 days; or at least 70 deg. F for at least 3 days, and then at least 40 deg. F for at least 4 more days.
 - b. Hot Weather Requirements: When hot weather conditions may cause an evaporation rate exceeding 0.2 pounds of water per square foot per hour, cure flatwork for at least the first 24 hours by water curing, fogging and sprinkling absorbent coverings, or wet covering curing methods.
 - 2. Comply with ACI 308.1 requirements for concrete curing, utilizing one or more of the methods indicated below that do not mottle, discolor, or stain the concrete.
 - 3. Begin curing concrete promptly after free water has disappeared from flatwork surfaces after finishing.
 - 4. Comply with ACI 308.1 requirements for preventing flatwork from becoming dry during curing.

- B. Curing Compounds: Either before or after bleed water has disappeared, at the discretion of the curing compound or MVES manufacturer, keep concrete flatwork surfaces continuously moist during the curing period by one of the following curing methods.
1. Promptly after troweling or finishing, and as soon as it can be accomplished without marring or damaging concrete finish, mist concrete surfaces with water and apply curing compound uniformly in one continuous operation in conformance with its manufacturer instructions.
 - a. When the curing compound manufacturer recommends a coverage range, either use heavier application rate or consult with Architect and manufacturer for appropriate coverage rate based upon intended use.
 - b. Do not exceed manufacturer's recommended coverage rate.
 2. Maintain continuity of coating and repair damage during curing period.
 - a. Examine application at regular intervals to verify compound film is intact.
 - b. If damaged, moisten the concrete and apply additional compound.
 - c. Recoat areas subjected to heavy rainfall within three hours after initial application.
 3. Special Techniques:
 - a. Uniformly apply 2 coats in a continuous operation with second coat at right angle to first coat. Total coverage for two coats may not exceed 200 square feet per gallon of undiluted compound, unless otherwise recommended by the manufacturer's written instructions.
 - b. The compound must form a uniform, continuous film that will not crack or peel. Promptly apply an additional coat of compound to areas where film is defective.
 - c. Recoat concrete surfaces subjected to rainfall within 3 hours after the curing compound application.
 - d. Maintain compound on the concrete surface throughout the curing period and immediately repair any damage.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
- B. Manufacturer Services: Installed work is subject to examination by the manufacturer's representative to determine conformance to manufacturer's instructions and other requirements and recommendations.
1. Note all defective items and non-conforming work identified by the manufacturer's representative.
 2. Itemize into a punch list all noted items and record the manufacturer's requirements and recommendations for correcting each punch list item.
 3. Promptly bring all punch list items into conformance with the manufacturer's requirements and recommendations until accepted in writing by the Architect.
 4. Manufacturer's representative withholds issuing warranties until all punch list items are accepted by the Architect.

3.7 CORRECTION AND REPAIR

- A. Non-conforming and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from the Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.8 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.9 PROTECTION

- A. Protect flatwork in place from soiling, deterioration, and damage until Substantial Completion, including
 - 1. heavy construction traffic;
 - 2. hard-wheeled traffic;
 - 3. impact and abrasion;
 - 4. imposed loads (e.g., cranes, concrete trucks);
 - 5. stains from grease, oil, chemicals, paint, plaster, clay, soil, and other sources;
 - 6. rubber tire marks;
 - 7. deicers;
 - 8. freezing;
 - 9. fireproofing applications specified in Division 07;
 - 10. chemicals, fluids, and other items present during testing of fire suppression systems specified in Division 21; and
 - 11. re-wetting after initial drying, including from rain, wash water, and spillage by other trades and other sources.
- B. Petroleum stains cannot be removed from concrete.
 - 1. Hydraulic powered equipment must be diapered to avoid concrete staining.

2. Other vehicle parking on flatwork is prohibited.
- C. Do not store anything on or adjacent to or against installed flatwork unless it is protected from damage. Use of pipe-cutting machines on flatwork is prohibited.
- D. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 03 35 40 – POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hybrid polished concrete finish.
2. Surface preparation.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the concrete polish manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected polished concrete densifier with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
2. Proposed substitution requests and submittals that change the quality (grade) or the generic chemistry of specified polished concrete are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
3. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the flooring manufacturer.
4. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and

- c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.
- B. Preinstallation Meeting:
1. Polished concrete manufacturer's representatives and installer must attend the preinstallation meeting specified in specification Section 03 35 10
 - a. Discuss burying MEP to achieve superior F(f) values.
 - b. Etc.
 2. Schedule a separate additional meeting after submittal approval and at least 10 business days before beginning installation.
 3. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including subfloor surface flatness and levelness, and special details and conditions that might affect installation
 4. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of polished concrete. Resolve each condition.
 5. Finalize construction schedule.
 6. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- C. Sequencing:
1. Install polished concrete only after concrete is cured to a condition of equilibrium; is sufficiently dry to bond with polished concrete; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer.
 2. Either delay polished concrete installation until after joint sealant installation is complete or protect sealant bond surfaces to prevent polished concrete migration onto joint surfaces. polished concrete application may only precede sealant application after sealant adhesion and compatibility are tested and verified using substrates, polished concrete, and sealant materials identical to those used in the work.
 3. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
 4. Install polished concrete only after penetrating items are installed.
 5. After polished concrete installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.
- D. Scheduling:
1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
 2. Cleaning: Schedule cleaning to prevent dust and other contaminants from falling on freshly-applied polished concrete.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished polished concrete.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for polished concrete maintenance, cleaning, and repair.
- D. Maintenance Material Submittals: Submit manufacturer-recommended cleaning materials, accessories, and manufacturer's instructions and other requirements and recommendations for maintenance and cleaning of polished concrete surfaces, including a comprehensive list of known chemicals that should not come into contact with polished concrete surfaces.
- E. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. polished concrete must be obtained through one source from the same manufacturer (to ensure compatibility and a uniform appearance).
 - a. Certain polished concrete may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. polished concrete provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

A. Regulatory Requirements:

1. Allowable Static Coefficient of Friction Value for Polish-Coated Flooring Surfaces (SCOF): At least 0.6 for level surfaces and at least 0.8 for sloped surfaces, when measured in conformance with ASTM D 2047.
2. Allowable Dynamic Coefficient of Friction Value for Hard Surface Flooring (DCOF): Between 0.35 and 0.45, with at least 0.42 minimum "passing" value, when measured in conformance with ANSI 326.3 under wet conditions.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing polished concrete for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing polished concrete for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading polished concrete installers.

C. Field Samples: Include *in-situ* mockups as part of the work of this specification section.

1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of polished concrete is made from field samples.
3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- ### A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective materials with undamaged new materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install polished concrete only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
1. Surface Conditions: Surfaces receiving polished concrete must be dry. Install polished concrete only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- C. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.

- 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Floor Seal Technology.
 - 2. L. M. Scofield Co.
 - 3. PROSOCO Inc.

2.3 HYBRID POLISHED CONCRETE FINISH

- A. Description: Combination of mechanical grinding, honing, and polishing concrete floor surfaces with bonded abrasive to achieve the specified aggregate exposure and friction rubbing with waxes or resins to achieve specified finish gloss.
- B. Products: "Consolideck System" manufactured by PROSOCO Inc., or equal.
- C. Requisite Properties:
 - 1. Densifier Type: Lithium silicate.
 - 2. Dye Color: Indicated on the Drawings.
 - 3. CPAA Aggregate Exposure Classification: Indicated on the Drawings in the Finish Legend, Sheet A6.30.
 - 4. CPAA Finish Gloss Level: Indicated on the Drawings in the Finish Legend, Sheet A6.30.
- D. Components: Provide the following manufactured by PROSOCO Inc., or equal.
 - 1. Sealer, Hardener, Densifier: "Consolideck LS".
 - 2. Color Dye: "Consolideck GemTone Stain".
 - 3. Protective Sealer: "Consolideck LSGuard".
 - 4. Maintenance Cleaner: "Consolideck LSKlean".

2.4 MIXING

- A. Open concrete polish containers only as required for use and mix only in designated areas.
- B. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- C. Do not reduce, alter, or introduce foreign materials into polished concrete, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with polished concrete appearance or performance.
 - 3. Verify items penetrating concrete are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and polished concrete installation.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
 - 3. Opening Protection: Close and protect drains and other openings and penetrations to prevent polished concrete intrusion or migration of liquids.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install polished concrete using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Only install polished concrete under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. polished concrete surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed polished concrete must be warrantable. Do not install, correct, or replace polished concrete in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Produce uniform finished surfaces without substrates, undercoats, marks, or stains showing through. Produce sharp and even lines and color breaks.
2. Polish surfaces behind movable equipment and furniture the same as adjacent exposed surfaces. [Coat] surfaces behind permanently fixed equipment or furniture with prime coat only.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.

2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed polished concrete in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to installed polished concrete unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed polished concrete surfaces as work surfaces.

END OF SECTION

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SECTION 03 54 16 – HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydraulic cement underlayment.
2. Patching material.
3. Surface preparation.
4. Installation materials.
5. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish flooring; and for remedial MVER products.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the cement underlayment manufacturer, unless otherwise indicated.
2. Underlayment: Means a material installed over subfloors to help achieve specified floor flatness values, and to smooth and correct surface irregularities prior to flooring installation

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected cement underlayment with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
2. Proposed substitution requests and submittals that change the quality (grade) or the generic chemistry of specified cement underlayment are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.

3. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the cement underlayment manufacturer.
 4. Coordinate cement underlayment primers with concrete curing compounds.
 - a. When accepted in writing by the manufacturer's field representative, specified cement underlayment may be applied over concrete slabs treated with either a silicate or acrylic resin curing compound.
 - b. Wax- and petroleum-based emulsions are permanent bond breakers that must be completely removed by mechanical means prior to patching or leveling.
 - c. Dissipating compounds must be completely removed by mechanical means prior to patching or leveling.
 - d. In all cases, acid etching, adhesive removers, solvents, and sweeping compounds are prohibited.
 5. When covering plywood or OSB subfloor sheathing with cement underlayment, additional measures must be taken to avoid concrete topping or concrete mix water leaching into subflooring. (concrete topping and concrete toppings seal the upper surface and moisture must travel through the full depth of subflooring to escape, which may delay ceiling finish installation to avoid trapping moisture within the assembly)
 6. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.
- B. Sequencing:
1. Install cement underlayment only after concrete is cured to a condition of equilibrium; is sufficiently dry to bond with cement underlayment; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible surface treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
 2. Install cement underlayment only after penetrating items are installed.
- C. Scheduling:
1. Concrete Substrate Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
 2. Primer Installation: Cement underlayment must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
 3. Finishing Flooring Installation: Do not install floor coverings until after the minimum time recommended in writing by the manufacturer has passed.

4. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling load traffic for at least 72 hours.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished cement underlayment.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 1. Cement underlayment must be obtained through one source from the same manufacturer (to ensure compatibility and a warrantable installation).

- a. Certain cement underlayments may be obtained from more than one manufacturer, but only when used for separate installations.
- b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing cement underlayment for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing cement underlayment for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading cement underlayment installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
 1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.

- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective cement underlayment materials with undamaged new cement underlayment materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install cement underlayment only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Surface Conditions: Install cement underlayment only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
1. ARDEX Group.
 2. Custom Building Products.
 3. Floor Seal Technology, Inc.
 4. LATICRETE International, Inc.
 5. Mapei Corp.

2.3 HYDRAULIC CEMENT UNDERLAYMENT

- A. Description: Portland-cement-based, non-structural, engineered cementitious material specifically designed for use as interior flooring cement underlayment. Products with added gypsum are prohibited.

- B. Application: Installed over subfloors to help achieve specified floor flatness values; and to smooth and correct surface irregularities prior to flooring installation.
- C. Self-Leveling Products:
 - 1. Pourable Grade Cement Underlayment Applications (0 to 1-1/4 inches thick):
"ARDEX V-1200" self-leveling, no-troweling cement underlayment manufactured by ARDEX Americas, or equal. Primer is required.
 - 2. High-Flow Cement Underlayment Applications (1/16- to 1/2-inch thick):
"ARDEX K 10" reactivatable high-flow, self-leveling cement underlayment manufactured by ARDEX Americas, or equal. Primer is required.
 - 3. Thicker Cement Underlayment Applications (1/4-inch to 5 inches thick):
"ARDEX K 15" self-leveling polymer-modified cement underlayment manufactured by ARDEX Americas, or equal. Primer is required.
 - a. For application thickness between 1/4-inch and 1-1/2 inches thick, apply neat.
 - b. For application thickness between 1-1/2 and 5 inches thick, apply with aggregate.
 - 4. Fiber Reinforced Underlayment Applications (1/4-inch to 5 inches thick):
"ARDEX K 22 F" high-flow, fiber-reinforced, self-leveling underlayment manufactured by ARDEX Americas, or equal. Primer is required.
 - a. For application thickness between 1/4-inch and 1-1/4 inches thick, apply neat.
 - b. For application thickness between 1-1/4 and 2 inches thick, apply with aggregate.
- D. Trowel Grade Products:
 - 1. Non-Structural Repair, Re-Slope, and Re-Forming Material: "ARDEX CP" Portland cement-based concrete topping for filling and repairing indoor and outdoor concrete flatwork manufactured by ARDEX Americas, or equal.
 - 2. Structural Repair Mortar: "ARDEX ERM" Polymer modified structural repair mortar with integral corrosion inhibitor manufactured by ARDEX Americas, or equal.

2.4 PATCHING MATERIAL

- A. Patching Compound: "ARDEX SD-F Feather Finish" self-drying finishing cement underlayment manufactured by ARDEX Americas, or equal. Primer is typically not required.

2.5 SURFACE PREPARATION

- A. Substrate Testing and Surface Preparation: Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16.
- B. Concrete Surface Profiling: Provide ICRI concrete surface profile CSP 3 to CSP 5 (light to medium shotblast between 10 and 40 mils), unless otherwise explicitly required, recommended, or accepted in writing by the covering manufacturer. Conform to the requirements of Section 09 05 16.

2.6 INSTALLATION MATERIALS

- A. Primers:
 - 1. Standard Absorbent Concrete, Gypsum, and Other Porous Substrates (in Specialized Applications): "ARDEX P 51" manufactured by ARDEX Americas, or equal.
 - a. Two applications of primer must be applied over gypsum cement underlayment.
 - b. Two applications of primer may be required over absorbent concrete cement underlayment.
 - 2. Wood, Cutback Residue, Metal, and Other Non-Porous Substrates: "ARDEX P 82 ULTRA PRIME" manufactured by ARDEX Americas, or equal.
- B. Additive: "ARDEX E 25" resilient emulsion manufactured by ARDEX Americas, or equal, for use over cutback and other adhesive residues on concrete subfloors only; over metal; and as part of mesh-reinforced wood subfloor systems.
- C. Crack Repair Compound: "ARDEX ARDIFIX" 100-percent solids, 2-part polyurethane repair compound manufactured by ARDEX Americas, or equal, for repair of non-moving joints and cracks.
- D. Joint Filler: "ARDEX ARDISEAL Rapid Plus" 2-part, self-leveling, semi-rigid polyurea joint filling compound manufactured by ARDEX Americas, or equal, for repair of all moving joints.
- E. Sand: Washed masonry or plaster sand, 1/8-inch diameter and smaller.
- F. Aggregate: Well-graded washed gravel, 1/8- to 1/4-inch diameter or larger, supplied, required, recommended, or accepted by the manufacturer for proposed thicknesses.
- G. Mix Water: Provide fresh, clean, clear, potable water from a domestic source. Water must conform to ASTM C 1602 and be free of oil, grease, waxy films, curing compounds, release agents, and other deleterious materials, including salts, acids, alkalis, organic materials, detergents, and other matter that might negatively affect cement underlayment quality, durability, or performance.

2.7 ACCESSORIES

- A. Perimeter Isolation Strips: Supplied, required, recommended, or accepted by the manufacturer.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.8 MIXING

- A. Site Mixing: Batch mix cement underlayment in conformance with manufacturer's instructions and other requirements and recommendations, using manufacturer-

recommended techniques and manufacturer-recommended mechanical mixing equipment, which must be clean and free of material from previously mixed batches before charging each subsequent batch.

1. Measure mix materials using only graduated mixing containers and calibrated mixing equipment. Shovels do not qualify as graduated mixing containers or calibrated equipment and are prohibited from measuring or dispensing mix materials.
2. Thoroughly agitate and stir mix materials to a uniform and smooth consistency suitable for proper installation.
3. Do not reduce, alter, or introduce foreign materials into mix materials, , including primers, additives, compounds, and fillers, except in conformance with manufacturer's instructions and other requirements and recommendations.
4. Do not use caked or lumpy materials; or materials that are irregular, too thick or too thin, or that are partially set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 3. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with cement underlayment adhesion or performance.
 4. Verify items penetrating cement underlayment are installed.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:

1. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
 2. Opening Protection: Close and protect drains and other openings and penetrations to prevent cement underlayment intrusion or migration.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
1. Remove substrate coatings and other substances that are incompatible with cement underlayment or that may negatively affect the quality of installation, durability, or performance.
 2. Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16. Provide ICRI concrete surface profile CSP 3 to CSP 5 (light to medium shotblast between 10 and 40 mils), unless otherwise explicitly required, recommended, or accepted in writing by the manufacturer.
 3. Repair damaged sub-floor and fill cracks.
 4. Vacuum-clean substrate.

3.3 INSTALLATION

- A. General Requirements:
1. Install cement underlayment using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Remove and replace cement underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.
 3. Installed cement underlayment must be warrantable. Do not install, correct, or replace cement underlayment in a manner that is un-warrantable by the manufacturer; or that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Thickness: Install screeds as required, recommended, or accepted by the manufacturer.
 - a. Set screeds with a laser level so the minimum cement underlayment thickness is at least 1/8-inch.
 - b. Where cement underlayment covers only a small area, grind, chisel, and undercut floor and deck slabs as necessary to ensure a minimum cement underlayment thickness of at least 1/8-inch.
 2. Place cement underlayment in one continuous operation, without cold joints, to produce uniform and level surfaces.
 - a. Screed cement underlayment to levels and tolerances required, recommended, or accepted by the finish flooring manufacturer.
 - b. Feather edges to match adjacent floor elevations.

3. Cure cement underlayment in conformance with the manufacturer's instructions. Protect cement underlayment to prevent contamination during installation and curing.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, and soiling from adjacent surfaces.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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DIVISION 04

MASONRY

SECTION 042000 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete block.
- B. Mortar and grout.
- C. Reinforcement and anchorage.
- D. Flashings.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 031000 - Concrete Forming and Accessories: Dovetail slots for masonry anchors.
- C. Section 032000 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- D. Section 076200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- E. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. ACI 216 - Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies.
 - 2. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
 - 4. ASTM C5 - Specification for Quicklime for Structural Purposes.
 - 5. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
 - 6. ASTM C91/C91M - Standard Specification for Masonry Cement.
 - 7. ASTM C110 - Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone.
 - 8. ASTM C114 - Method for Chemical Analysis of Hydraulic Cement.
 - 9. ASTM C140 - Sampling and Testing Concrete Masonry Units.
 - 10. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.

11. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 12. ASTM C150/C150M - Standard Specification for Portland Cement.
 13. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes.
 14. ASTM C260 - Specification for Air-Entraining Admixtures for Concrete.
 15. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 16. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 17. ASTM C426 - Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
 18. ASTM C476 - Standard Specification for Grout for Masonry.
 19. ASTM C494 - Specification for Chemical Admixtures for Concrete.
 20. ASTM C744 - Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
 21. ASTM C979 - Specification for Pigments for Integrally Colored Concrete.
 22. ASTM C1019 - Test Method of Sampling and Testing Grout.
 23. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
 24. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
 - a. Chapter 17 - Structural Tests and Inspections.
 - b. Chapter 21 - Masonry.
- C. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.
- D. International Association of Plumbing and Mechanical Officials (IAPMO):
1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for brickwork support system.
- D. Samples: Submit samples of units to illustrate color, texture, and extremes of color range.

- E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
- G. Installer's Qualification Statement.
- H. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.
 - c. Product Data for MR Credit 5.1 and MR Credit 5.2: For regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 MATERIALS, CONSTRUCTION AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH TMS 402/602 AND CBC CHAPTER 21.

2.2 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm)
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher
 - 5. Preference is given to Declare labels designated as Red List Free
- E. Low-Emitting Materials criteria
 - 1. VOC content criteria

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
2. VOC emissions criteria or inherently non-emitting
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.3 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and by thickness of wall as indicated on contract drawings
 - a. Cap units shall be 2 inches high by 16 inches long by thickness of wall.
 2. Shapes: Provide open end units typically.
 - a. Bond Beam Block: Deep cut type.
 - b. Provide lintel units over wall openings.
 - c. Special Units: Provide cap, end, corner, pilaster, and other special units as required.
 3. Load-Bearing Units: ASTM C90, medium weight.
 - a. Hollow block, as indicated.
 4. Nonloadbearing Units: ASTM C129.
 - a. Hollow block, as indicated.
 5. Average oven-dry density of solid grouted medium weight CMU block shall not exceed 115 pounds per cubic foot.
 6. Admixture: Add water repellent admixture to block mix used for exterior construction in accordance with recommendations of manufacturer.
 7. Surface Texture:
 - a. Buildings: Provide smooth precision block surface, or as indicated on drawings.
 - b. Site Walls: Split-Face Units, or as indicated in drawings.
 8. Block Color:
 - a. Smooth: Provide natural color unless noted otherwise on the Contract Drawings.
 - b. Split Face: Provide color as noted on the Contract Drawings.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type II; color as required to produce approved color sample.
- B. Hydrated Lime: ASTM C207, Type S.

- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404, coarse type.
- E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
 - 1. Color(s): To match block color.
- F. Water: Clean and potable.
- G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
 - 1. Use only in combination with masonry units manufactured with integral water repellent admixture.
 - 2. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
 - 3. Meet or exceed performance specified for water repellent admixture used in masonry units.

2.5 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: Type specified in Section 032000; size as indicated on drawings.
- B. Supports and spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

2.6 FLASHINGS

- A. Metal Flashing Materials: As specified in Section 076200.

2.7 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Type as indicated on drawings.
 - 2. Minimum compressive strength of the mortar shall be as required to achieve the compressive strength (f_m) of masonry specified when combined with masonry units used in the structure.
 - 3. Proportion per CBC Chapter 21 and TMS 402/602.
 - 4. Water Repellent Admixture: Add water repellent admixture to mortar mix in accordance with recommendations of manufacturer.

- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
 - 1. Minimum compressive strength of the grout shall be as required to achieve the compressive strength (f'm) of masonry specified when combined with masonry units used in the structure, with a minimum compressive strength of 2500 psi.
 - 2. Proportions: In accordance with ASTM C376.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.8 PERFORMANCE CRITERIA

- A. Minimum specified average net area compressive strength (f'm) of masonry assembly shall be in accordance with the contract drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Verify dowels are properly located.
- D. Do not commence installation until foundations are clean, rough, and level, or until floor slabs are structurally sound. Clean projecting dowels free from loose scale, dirt, concrete, and other material that will inhibit bond.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of TMS 402/602 and CBC Chapter 22.

3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Mortar Joints: Concave.

3.5 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Lay only dry masonry units
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners, except for units laid in stack bond.
- G. Provide full mortar coverage on horizontal and vertical face shells and webs in courses of the following:
 - 1. Piers, columns, and pilasters.
 - 2. Starting course on footings and solid foundation walls. Provide full bedding under both the face shell and web.
 - 3. Where adjacent to cells or cavities to be filled with grout.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- J. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
- K. If necessary to stop a horizontal run of masonry, rack back one-half block length in each course. Do not use toothing to join new masonry to set or partially set masonry when continuing a horizontal run.
- L. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

M. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

N. Horizontal and Vertical Face Joints:

1. Thickness: 3/8-inch nominal, and uniform in appearance.
2. When thumb-print hard, tool joints in exposed surfaces with round jointer for concave joint. Mortar joints shall be tooled only where walls will be left exposed.
 - a. Compress and strike off for flush joints when serving as a base for plaster, textured coatings, membrane waterproofing or dampproofing.
3. Remove mortar protruding into cells of cavities to be reinforced or filled.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Provide reinforcing as shown on contract drawings.
- B. Install reinforcing in conformance with TMS 402/602.

3.7 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.8 GROUTED COMPONENTS

- A. Lap splices as indicated on drawings.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

3.9 CONTROL JOINTS

- A. Continue horizontal joint reinforcement through control joints.
- B. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.

3.10 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.

1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.11 TOLERANCES

A. Install masonry within the site tolerances found in TMS 402/602.

3.12 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

3.14 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.15 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

B. Cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

C. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

D. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

END OF SECTION 042000

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SECTION 04 43 13 – ANCHORED STONE VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Anchored stone veneer.
 - 2. Installation materials.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the stone veneer supplier, or installation material, or accessory manufacturer, as the context admits, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting:
 - 1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 - 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation.
 - 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed stone veneer. Resolve each condition.
 - 4. Finalize construction schedule.
 - 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- B. Sequencing: Install stone veneer only after penetrating items are installed and after overhead finishing operations are complete.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: For manufactured items, submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned elevations drawn to scale and showing wall design patterns. Layouts, and attachment to supporting structure.
 - b. Include project-specific dimensioned details drawn to scale showing attachments to supporting construction and conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to elevations.
 - 3. Samples: Submit at least 18-inch square representative samples of each stone veneer variety for each specified color and finish, glued to hardboard backing. Grout all joints with specified grout.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished stone veneer, installation materials, and accessories.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals: Before Final Completion, deliver to the Owner stone veneer cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 - 1. Furnish at least 2 percent of the total installed for each stone veneer type, color, composition, grade, finish, and variety.
 - 2. Furnish at least 2 percent of the total amount installed for each grout type, color, and composition. but not less than one unopened container.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.

2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Stone veneer must be obtained through one source from the same supplier (to ensure compatibility and appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Installation Materials (Setting Materials): Installation materials must be obtained through one source from the same manufacturer (to ensure compatibility and a warrantable installation).
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Quality Standard Requirements:

1. Anchorage: Comply with ASTM C 1242 requirements for the design of stone anchors and anchoring systems.

C. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing stone veneer for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing stone veneer for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading stone veneer installers.

D. Field Samples: Include *in-situ* mockups as part of the work of this specification section.

1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.

2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of stone veneer is made from field samples.
3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective materials with undamaged new materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install stone veneer only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.

B. Existing Conditions:

1. Substrate Dimensional Tolerances: Surfaces receiving stone veneer must be flat with 1/4-inch within any 10-foot radius.
2. Deflection: Maximum deflection of substrate system under positive or negative design loads must not exceed L/480.

PART 2 - PRODUCTS

A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:

1. 018113 Sustainable Design Requirements

B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
2. Preference is given to product-specific type III EPDs.
3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.

C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.

1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

D. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURED STONE

- A. Products: "Hillstone" manufactured by Eldorado Stone, or equal.
- B. Requisite Properties:
 1. Size: Indicated on the Drawings.
 2. Thickness: 3/4-inch to 2 inches.
 3. Color: Indicated on the Drawings.
 4. Finish: Indicated on the Drawings.
 5. Bond Pattern: Indicated on the Drawings.
 6. Joints: Indicated on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Hat Furring Channels:
 1. Products: Provide one of the following, or equal.
 - a. "FC Series Furring Channel" manufactured by ClarkDietrich Building Systems.
 - b. "Prime Wall Furring Channel" manufactured by The Steel Network.
 2. Requisite Properties:
 - a. Depth: 7/8- or 1-1/2-inch deep channels, as indicated.
 - b. Thickness: 43 mils (18-gage).
 - c. Web: 1-1/4 inches wide.
 - d. Screw Flanges: 3/4-inch wide.
- B. Fasteners: 3-coat anti-corrosive or ceramic-coated anti-corrosive steel screw fasteners specified in Section 05 05 23 with gasketed washers.
- C. Anchor System: Provide DW-10HS Veneer Anchors manufactured by Hohmann & Barnard, or equal.
- D. Mortar:
 1. Description: Premium-grade (best quality grade), single-component, ultra-high-performance, polymer-modified Portland cement mortar conforming to A118.15 shear bond strength requirements.

2. Application: Used for the installation of exterior natural stone veneer.
 3. Restrictions: May not be used for installations over particle board, luan, hardboard (Masonite), or hardwood flooring.
 4. Products: Provide one of the following, or equal.
 - a. "MegaFlex Crack Prevention Mortar" manufactured by Custom Building Products.
 - b. "254 Platinum" manufactured by LATICRETE International, Inc.
 - c. "Ultraflex 3" manufactured by Mapei Corp.
- E. Mix Water: Provide fresh, clean, clear, potable water from a domestic source. Water must conform to ASTM C 1602 and be free of oil, grease, waxy films, curing compounds, release agents, and other deleterious materials, including salts, acids, alkalis, organic materials, detergents, and other matter that might negatively affect stone veneer quality, durability, appearance, or performance.

2.4 ACCESSORIES

- A. Trim Units: Coordinate with sizes and coursing of adjoining flat stone facing where applicable. Provide shapes as indicated.
- B. Setting Shims: Strips of resilient plastic or vulcanized neoprene, minimum Shore A hardness of between 50 and 70, non-staining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.
- C. Concealed Sheet Metal Flashing: Fabricate from stainless steel specified in Section 07 62 00.
- D. Grout Release:
1. Description: Temporary, water soluble, pre-grout coating.
 2. Application: Used to provide protection against grout & mortar staining.
 3. Products: Provide one of the following, or equal.
 - a. "Aqua Mix Grout Release" manufactured by Custom Building Products.
 - b. "STONETECH Grout Release" manufactured by LATICRETE International, Inc.
 - c. "UltraCare Grout Release" manufactured by Mapei Corp.
- E. Joint Sealant:
1. Description: 100-percent silicone joint sealant.
 2. Products: Provide the following manufactured by Laticrete International, Inc., or equal.
 - a. Sealant: "LATICRETE Latisil", or equal.
 - b. Primer: "LATICRETE Latisil 9118", or equal.
 3. Color: Custom color, sanded with stone fines to match grout joint color.
- F. Rough Opening and Penetration Flashing Sealant: Specified in Section 07 27 13.

- G. Stone Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed stone veneer and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering stone veneer and grout surfaces.
- H. Grout Sealer: Manufacturer's standard product for sealing grout joints, which does not change either the color or appearance of installed grouts.
- I. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 MIXING

- A. Site Mixing: Batch mix installation materials in conformance with manufacturer's instructions and other requirements and recommendations, using manufacturer-recommended techniques and manufacturer-recommended mechanical mixing equipment, which must be clean and free of material from previously mixed batches before charging each subsequent batch.
 - 1. Measure mix materials using only graduated mixing containers and calibrated mixing equipment. Shovels do not qualify as graduated mixing containers or calibrated equipment and are prohibited from measuring or dispensing mix materials.
 - 2. Thoroughly agitate and stir mix materials to a uniform and smooth consistency suitable for proper installation.
 - 3. Do not reduce, alter, or introduce foreign materials into mix materials, except in conformance with manufacturer's instructions and other requirements and recommendations.
 - 4. Do not use caked or lumpy materials; or materials that are irregular, too thick or too thin, or that are partially set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations, including dimensional tolerances and deflection criteria.
 - 2. Verify items penetrating stone veneer are installed.
- C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install stone veneer in conformance with the specified quality standard requirements using materials and methods required, recommended, or accepted by the installation material or accessory manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set stone veneer to line; plumb, level, and square without warp or lipping; with uniform, well-fitted joints and in alignment with adjacent construction
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed stone veneer must be warrantable. Do not install, correct, or replace stone veneer in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. If furring is installed vertically, set furring in weather barrier sealant at all fastener locations. If furring is installed horizontally, install furring over weather barrier shims specified in Section 07 27 13.
2. Accurately form intersections and returns. Perform cutting and drilling without marring visible surfaces. Carefully grind cut edges abutting trim, finishes, or built-in items for straight aligned joints. Fit stone veneer closely to penetrating items so plates, collars, or covers overlap stone veneer.
3. Jointing Pattern: Lay stone veneer in patterns as indicated on the Drawings.
 - a. Ensure stone veneer is the same size indicated on the Drawings and joints align.
 - b. Lay out and center stone veneer in both directions in each space or on each wall area. Adjust to minimize cutting.
 - c. Provide uniform joint widths, unless otherwise indicated.
4. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, during installation.
 - a. Locate joints in stone veneer surfaces directly above substrate joints.
 - b. Prepare joints and apply sealants in conformance with the requirements in Section 07 92 00.
 - c. Do not saw-cut joints after installing stones
5. Grout Sealer: Apply grout sealer to cementitious grout joints in conformance with the grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on stone veneer by wiping with soft cloth.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere stone veneer to supporting construction.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible stone veneer surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed stone veneer in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything adjacent to or against installed stone veneer unless it is protected from damage, as accepted in writing by the Architect. Do not use installed stone veneer as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 04 74 14 – ADHERED MANUFACTURED STONE VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered manufactured stone veneer.
2. Veneer waterproofing.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. TCNA: Tile Council of North America.

B. Definitions:

1. Manufacturer: Means the manufactured stone veneer, installation material, or accessory manufacturer, as the context admits, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected waterproofing and crack isolation membranes and mortar with installed curing compounds and moisture vapor emission control systems, based on current product formulations.
2. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified mortar and grout are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.

B. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.

2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation.
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed manufactured stone veneer. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Substrate repairs must be completed after surface preparation.
2. Install manufactured stone veneer only after penetrating items are installed and after overhead finishing operations are complete.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned elevations drawn to scale and showing wall design patterns and layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to elevations.
3. Samples: Submit at least 18-inch square representative samples of each manufactured stone veneer variety for each specified color and finish, glued to hardboard backing. Grout all joints with specified grout.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished manufactured stone veneer, installation materials, and accessories.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.

- b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals: Before Final Completion, deliver to the Owner manufactured stone veneer cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 - 1. Furnish at least 2 percent of the total installed for each manufactured stone veneer type, color, composition, grade, finish, and variety.
 - 2. Furnish at least 2 percent of the total amount installed for each grout type, color, and composition. but not less than one unopened container.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Manufactured stone veneer must be obtained through one source from the same supplier (to ensure compatibility and appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Installation Materials (Setting Materials): Installation materials, including waterproofing membranes, crack isolation membranes, mortar, adhesive, grout, sealers, and other installation materials and accessories must be obtained through one source from the same manufacturer (to ensure compatibility and a warrantable installation).

3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Quality Standards:
1. Installation Standards: Comply with parts of ANSI A108 Series publication requirements that apply to types of setting and grouting materials and to installation methods indicated.
 2. Installation Guidelines: Comply with TCNA publication "*Handbook for Ceramic, Glass, and Stone Installation*" requirements for installation methods indicated.
- C. Qualifications:
1. Installer: Company or individuals must have at least 5 years' experience installing manufactured stone veneer for at least 30 previous projects similar to this project in size, material, design, and complexity.
 2. Supervisors: Individuals must have at least 7 years' experience installing manufactured stone veneer for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading manufactured stone veneer installers.
- D. Field Samples: Include *in-situ* mockups as part of the work of this specification section.
1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
 2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of manufactured stone veneer is made from field samples.
 3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
 4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.

3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
 - C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
 - D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective materials with undamaged new materials that do not exhibit deterioration, damage, or defects.
 - E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.
- 1.7 PROJECT CONDITIONS
- A. Ambient Conditions: Install manufactured stone veneer only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
 - B. Existing Conditions:
 1. Substrate Dimensional Tolerances: Surfaces receiving manufactured stone veneer must be flat with 1/4-inch within any 10-foot radius.
 2. Deflection: Maximum deflection of substrate system under positive or negative design loads must not exceed L/480.

PART 2 - PRODUCTS

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.

3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURED STONE

- A. Products: "Hillstone" color "Lucera" manufactured by Eldorado Stone, or equal.
- B. Requisite Properties:
 1. Size: Indicated on the Drawings.
 2. Thickness: 3/4-inch to 2 inches.
 3. Color: Indicated on the Drawings.
 4. Finish: Indicated on the Drawings.
 5. Bond Pattern: Indicated on the Drawings.
 6. Joints: Indicated on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Thickbed Mortar Base: Cementitious scratch and brown coats and supporting framework.
- B. Fluid-Applied Waterproofing / Crack Isolation Membrane:
 - 1. Description: Self-curing liquid rubber polymer/reinforcing fabric flexible waterproofing membrane system conforming to ANSI A118.10 requirements for exterior applications.
 - 2. Application: Vertical and horizontal surface ceramic tile, stone and brick installations over cement plaster and cement backer board.
 - 3. Restrictions: May not be used for exterior installations that have occupied space (interior spaces requiring protection from water infiltration) beneath the installation; or that are on wood framed decks.
 - 4. Waterproofing Membrane: "LATICRETE 9235 Waterproofing Membrane" manufactured by Laticrete International, Inc., or equal.
 - 5. Reinforcing Fabric: "LATICRETE Waterproofing/Anti-Fracture Fabric" alkali-resistant reinforcing mesh manufactured by Laticrete International, Inc., or equal.
 - 6. Accessories: Provide accessories and secondary items supplied, required, recommended, or accepted by the waterproofing/crack isolation membrane manufacturer for actual in-service conditions applicable to the project.
- C. Polymer-Modified Cementitious Mortar:
 - 1. Description: Premium-grade (best quality grade), single-component, ultra-high-performance, polymer-modified Portland cement mortar conforming to A118.15 shear bond strength requirements.
 - 2. Application: Used for the installation of exterior natural manufactured stone veneer.
 - 3. Restrictions: May not be used for installations over particle board, luan, hardboard (Masonite), or hardwood flooring.
 - 4. Products: Provide one of the following, or equal.
 - a. "MegaFlex Crack Prevention Mortar" manufactured by Custom Building Products.
 - b. "254 Platinum" manufactured by LATICRETE International, Inc.
 - c. "Ultraflex 3" manufactured by Mapei Corp.
- D. Mix Water: Provide fresh, clean, clear, potable water from a domestic source. Water must conform to ASTM C 1602 and be free of oil, grease, waxy films, curing compounds, release agents, and other deleterious materials, including salts, acids, alkalis, organic materials, detergents, and other matter that might negatively affect manufactured stone veneer quality, durability, appearance, or performance.

2.4 ACCESSORIES

- A. Grout Release:
 - 1. Description: Temporary, water soluble, pre-grout coating.
 - 2. Application: Used to provide protection against grout & mortar staining.

3. Products: Provide one of the following, or equal.
 - a. "Aqua Mix Grout Release" manufactured by Custom Building Products.
 - b. "STONETECH Grout Release" manufactured by LATICRETE International, Inc.
 - c. "UltraCare Grout Release" manufactured by Mapei Corp.
- B. Joint Sealant:
 1. Description: 100-percent silicone joint sealant.
 2. Products: Provide the following manufactured by Laticrete International, Inc., or equal.
 - a. Sealant: "LATICRETE Latisil", or equal.
 - b. Primer: "LATICRETE Latisil 9118", or equal.
 3. Color: Custom color, sanded with stone fines to match grout joint color.
- C. Stone Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed manufactured stone veneer and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering manufactured stone veneer and grout surfaces.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints, which does not change either the color or appearance of installed grouts.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 MIXING

- A. Site Mixing: Batch mix installation materials in conformance with manufacturer's instructions and other requirements and recommendations, using manufacturer-recommended techniques and manufacturer-recommended mechanical mixing equipment, which must be clean and free of material from previously mixed batches before charging each subsequent batch.
 1. Measure mix materials using only graduated mixing containers and calibrated mixing equipment. Shovels do not qualify as graduated mixing containers or calibrated equipment and are prohibited from measuring or dispensing mix materials.
 2. Thoroughly agitate and stir mix materials to a uniform and smooth consistency suitable for proper installation.
 3. Do not reduce, alter, or introduce foreign materials into mix materials, except in conformance with manufacturer's instructions and other requirements and recommendations.
 4. Do not use caked or lumpy materials; or materials that are irregular, too thick or too thin, or that are partially set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations, including dimensional tolerances and deflection criteria.
 - 2. Verify items penetrating manufactured stone veneer are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of installation, durability, appearance, or performance of furnished manufactured stone veneer.
 - 2. Remove substrate ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface.
 - 3. Repair damaged substrate and fill cracks.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install manufactured stone veneer in conformance with the specified quality standards requirements using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set manufactured stone veneer to line; plumb, level, and square without warp or lipping; with uniform, well-fitted joints and in alignment with adjacent construction
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed manufactured stone veneer must be warrantable. Do not install, correct, or replace manufactured stone veneer in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Install waterproofing/crack prevention membrane in conformance with ANSI A108.13 and the waterproofing/crack prevention manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
2. Do not install manufactured stone veneer over waterproofing/crack prevention membrane until membrane has cured and been tested to determine that it is watertight.
3. Install manufactured stone veneer in conformance with the ANSI and TCNA quality standard publication requirements for wall installations.
4. Accurately form intersections and returns. Perform cutting and drilling without marring visible surfaces. Carefully grind cut edges abutting trim, finishes, or built-in items for straight aligned joints. Fit manufactured stone veneer closely to penetrating items so plates, collars, or covers overlap manufactured stone veneer.
5. Jointing Pattern: Lay manufactured stone veneer in patterns as indicated on the Drawings.
 - a. Ensure manufactured stone veneer is the same size indicated on the Drawings and joints align.
 - b. Lay out and center manufactured stone veneer in both directions in each space or on each wall area. Adjust to minimize cutting.
 - c. Provide uniform joint widths, unless otherwise indicated.
6. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, during installation..
 - a. Locate joints in manufactured stone veneer surfaces directly above substrate joints.
 - b. Prepare joints and apply sealants in conformance with the requirements in Section 07 92 00.
 - c. Do not saw-cut joints after installing stones
7. Thresholds: Install thresholds at locations indicated; set in same type of setting bed as abutting field manufactured stone veneer, unless otherwise indicated.
8. Grout manufactured stone veneer in conformance with the ANSI and TCNA quality standard publication requirements.
9. Grout Sealer: Apply grout sealer to cementitious grout joints in conformance with the grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on manufactured stone veneer by wiping with soft cloth.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere manufactured stone veneer to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible manufactured stone veneer surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed manufactured stone veneer in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything on, adjacent to or against installed manufactured stone veneer unless they are protected from damage, as accepted in writing by the Architect. Do not use installed manufactured stone veneer as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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DIVISION 05

METALS

SECTION 05 05 14 – SHOP-APPLIED STEEL PRIMER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-applied steel primer.
2. Repair materials.
3. Surface preparation.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 91 00 for painting steel surfaces installed in SSPC Environmental Zones 0 and 1A, including field-applied primers and spot primers.
3. Section 09 97 13 for high performance steel coatings applied to steel surfaces installed in SSPC Environmental Zones 1B, 2A, and 2B.

1.2 RELATED DOCUMENTS

A. This specification

1. supersedes any surface preparation and priming requirements, and
2. supplements the requirements of Section 09 97 13 to create complete high-performance steel coating systems.

1.3 REFERENCES

A. Abbreviations and Acronyms:

1. AISC: American Institute of Steel Construction.
2. DFT: Dry Film Thickness.
3. HDG: Hot-Dip Galvanized.
4. NACE: National Association of Corrosion Engineers.
5. NAAMM: National Association of Architectural Metal Manufacturers.

B. Definitions:

1. Manufacturer: Means the primer manufacturer, unless otherwise indicated.
2. SSPC Environmental Zones:

- a. Zone 0: Dry interiors where structural steel is embedded in concrete, encased in masonry, or protected by membrane or non-corrosive contact type fireproofing.
- b. Zone 1A: Normally-dry interior or temporary protection.
- c. Zone 1B: Normally-dry exteriors.
- d. Zone 2A: Frequently wet by fresh water, including condensation, splash, spray, or frequent immersion.
- e. Zone 2B: Frequently wet by salt water, including condensation, splash, spray, or frequent immersion.
- f. Zone 2C: Fresh water immersion. Coating is constantly submerged.
- g. Zone 2D: Saltwater immersion. Coating is constantly submerged.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

- 1. Unless otherwise indicated or required, prime all steel surfaces throughout the Project, except the following.
 - a. Items or portions of items receiving field-applied cementitious fireproofing, when accepted by the fireproofing manufacturer.
 - b. Items or portions of items embedded in concrete or mortar, except primer must extend at least 2 inches below the finished concrete surface of partially-embedded items.
 - c. Faying surfaces of connections using slip critical bolts.
 - d. Field-welded surfaces, including flange surfaces supporting metal decking.
 - e. HDG surfaces indicated as having a natural finish.
- 2. Coordinate primers for compatibility with paint and coating systems indicated in other specification sections.
- 3. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified primers are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
- 4. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.

1.5 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

- 1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding

material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Primer Schedule:
 - a. Prepare a list of specified primers and their project locations, with selected products identified by generic type and manufacturer's product name for each coat of every finish.
 - b. Identify substrates to which each specified primer is applied, including surface preparation methods for each substrate.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper primer surface preparation and installation.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 QUALITY ASSURANCE

A. Source Limitations:

1. Primer must be obtained through one source from the same manufacturer (to ensure compatibility).
 - a. Certain primers may be obtained from more than one manufacturer, but only when used for separate installations.

- b. Primers provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Quality Standard: Shop-primed items must conform to the requirements of NAAMM documents AMP 500, *"Metal Finishes Manual"* and AMP 504, *"Finishes for Carbon Steel and Iron"*.
- C. Qualifications:
 - 1. Installer: Company or individuals must have at least 5 years' experience installing primer for at least 30 previous projects similar to this project in size, material, design, and complexity. Only a company certified by the AISC as having a current P3-Sophisticated Painting Endorsement (SPE) certification may apply shop primers.
 - 2. Supervisors: Individuals must have at least 7 years' experience installing primer for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading primer installers.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install primer only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.

2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
3. Preference is given to product inventoried to at least 0.01% (100 ppm).
4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
5. Preference is given to Declare labels designated as Red List Free.

C. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Carboline Co.
 2. PPG Industries, Inc.
 3. Tnemec Co.

2.3 SHOP APPLIED STEEL PRIMER

- A. Acrylic Primer:
1. Description: Hydrophobic acrylic dry-fall high performance coating primer
 2. Application: Applied to interior exposed-in-service steel surfaces.
 3. Product: "Uni-Bond DF Series 115" manufactured by the Tnemec Co., or equal.
 4. Requisite Properties:

- a. Minimum Thickness: Between 2.0 and 3.5 mils DFT per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, *"Measurement of Dry Coating Thickness with Magnetic Gages"*.
- b. Color: Match Tnemec color 10-1009, "Gray".
5. Performance Requirements:
 - a. Minimum Dry Film Adhesion: At least a 5B rating, when tested in conformance with ASTM D 3359.
 - b. Minimum Humidity Resistance: No blistering, cracking, rusting, or delaminating of film after at least 500 hours exposure, when tested in conformance with ASTM D 4585.
 - c. Minimum Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film and no rust creep at scribe after at least 500 hours exposure, when tested in conformance with ASTM B 117.
 - d. Minimum Slip Coefficient Rating: At least 0.50 (AISC Class B surface), when tested in conformance with ASTM A 490.

B. Zinc-Rich Primer:

1. Description: Zinc-rich high-performance coating primer.
2. Application: Applied exterior exposed-in-service steel surfaces.
3. Product: "Tneme-Zinc Series 90-97" manufactured by the Tnemec Co., or equal.
4. Requisite Properties:
 - a. Minimum Thickness: Between 2.0 and 3.5 mils DFT per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, *"Measurement of Dry Coating Thickness with Magnetic Gages"*.
 - b. Color: Reddish-gray or other standard color.
 - c. Zinc Dust Pigment: ASTM D 520 Type III composition classification (not more than 0.002 percent lead).
5. Performance Requirements:
 - a. Minimum Dry Film Adhesion: At least 800 pounds per square inch pull, when tested in conformance with ASTM D 4541.
 - b. Minimum Humidity Resistance: No blistering, cracking, rusting, or delaminating of film after at least 1,000 hours exposure, when tested in conformance with ASTM D 4585.
 - c. Minimum Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film, and not more than 1/32-inch rust creep at scribe after at least 10,000 hours exposure, when tested in conformance with ASTM B 117.
 - d. Minimum Slip Coefficient Rating: At least 0.50 (AISC Class B surface), when tested in conformance with ASTM A 490.

2.4 REPAIR MATERIALS

A. Acrylic Spot Primer:

1. Description: Hydrophobic acrylic dry-fall high performance coating primer
2. Application: Applied to interior exposed-in-service steel surfaces.

3. Product: "Uni-Bond DF Series 115" manufactured by the Tnemec Co., or equal.
4. Requisite Properties:
 - a. Minimum Thickness: Between 2.0 and 3.5 mils DFT per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, "*Measurement of Dry Coating Thickness with Magnetic Gages*".
 - b. Color: Match Tnemec color 00WH, "Tnemec White".
5. Performance Requirements:
 - a. Minimum Dry Film Adhesion: At least a 5B rating, when tested in conformance with ASTM D 3359.
 - b. Minimum Humidity Resistance: No blistering, cracking, rusting, or delaminating of film after at least 500 hours exposure, when tested in conformance with ASTM D 4585.
 - c. Minimum Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film and no rust creep at scribe after at least 500 hours exposure, when tested in conformance with ASTM B 117.
 - d. Minimum Slip Coefficient Rating: At least 0.50 (AISC Class B surface), when tested in conformance with ASTM A 490.

B. Zinc-Rich Spot Primer:

1. Description: Zinc-rich aromatic urethane organic primer.
2. Application: Field-applied to repair damaged shop-applied zinc-rich primer.
3. Product: "Hydro-Zinc 94-H20" manufactured by the Tnemec Co., or equal.
4. Requisite Properties:
 - a. Minimum Thickness: Between 2.5 and 3.5 mils DFT per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, "*Measurement of Dry Coating Thickness with Magnetic Gages*".
 - b. Color: Greenish-gray or other standard color.
 - c. Zinc Dust Pigment: ASTM D 520 Type III composition classification (not more than 0.002 percent lead).
5. Performance Requirements:
 - a. Minimum Dry Film Adhesion: At least 800 pounds per square inch pull, when tested in conformance with ASTM D 4541.
 - b. Minimum Humidity Resistance: No blistering, cracking, rusting, or delaminating of film after at least 1,000 hours exposure, when tested in conformance with ASTM D 4585.
 - c. Minimum Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film, and not more than 1/32-inch rust creep at scribe after at least 10,000 hours exposure, when tested in conformance with ASTM B 117.
 - d. Minimum Slip Coefficient Rating: At least 0.50 (AISC Class B surface), when tested in conformance with ASTM A 490.

C. Other Spot Primers: Provide spot primer identical to shop-applied primer originally used to prime surfaces.

2.5 SURFACE PREPARATION

- A. Concealed and Interior Exposures:
 - 1. Application: Applied to steel items installed in SSPC Environmental Zones 0 and 1A (concealed and interior service conditions not subject to wetting).
 - 2. Surface Preparation: Prepare surfaces in conformance with manufacturer-prepared published and supplemental instructions, and SSPC surface preparation standard SSPC-SP3, "*Power Tool Cleaning*".
- B. Exterior Moderate Exposures and all AESS (regardless of location):
 - 1. Application: Applied to steel items installed in SSPC Environmental Zones 1B and 2A (moderate exterior service conditions).
 - 2. Surface Preparation: Prepare surfaces in conformance with manufacturer-prepared published and supplemental instructions, and SSPC surface preparation standard SSPC-SP6/NACE 3, "*Commercial Blast Cleaning*" to a minimum surface profile of at least 1.5 mils, when measured in conformance with ASTM D 4417 Method B (Surface Profile Depth Micrometer).
- C. Exterior Severe Exposures and Immersion Service:
 - 1. Application: Applied to steel items installed in SSPC Environmental Zone 2B (severe exterior service conditions), Zone 2C (freshwater immersion conditions), and Zone 2D (saltwater immersion conditions).
 - 2. Surface Preparation: Prepare surfaces in conformance with manufacturer-prepared published and supplemental instructions, and SSPC surface preparation standard SSPC-SP10/NACE 2, "*Near-White Blast Cleaning*" to a minimum surface profile of at least 2.0 mils, when measured in conformance with ASTM D 4417 Method B (Surface Profile Depth Micrometer).
- D. Unknown or Incompatible Primers:
 - 1. Application: Use when unknown shop- or factory-applied primers are discovered; or when high-performance steel primers are chemically or adhesively incompatible with shop- or factory-applied primers.
 - 2. Surface Preparation: Apply specified spot primer as a full prime coat on all surfaces as a tie-coat for subsequent intermediate and top coats.

2.6 ACCESSORIES

- A. Flash Rust Inhibitor/Salt Remover:
 - 1. Description: Blast and wash down-water additive that prevents flash rusting of wet abrasive and water-blasted ferrous metal surfaces; and of dry-blasted surfaces in a pressurized wash down.
 - 2. Product: "HoldTight 102" manufactured by HoldTight Solutions Inc., or equal.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed in the shop and at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify surfaces conform to the manufacturer's requirements or recommendations and satisfy all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed primers.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.
- D. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install primer using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Only install primers under conditions that ensure finishes are free from blemishes and defects.
 - 3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. Primer surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
 - 4. Do not exceed the application rates recommended by the manufacturer.
 - 5. Installed primers must be warrantable. Do not install, correct, or replace primers in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. To avoid surface contaminant pick-up, promptly prime prepared surfaces as soon as practicable after and within the same day as surface preparation.
 - 2. Verify primer film thickness during application by taking numerous measurements.

3.3 CORRECTION AND REPAIR

- A. Clean and prepare damaged primed surfaces in conformance with manufacturer's instructions and SSPC surface preparation standard SSPC-SP11 *"Power Tool Cleaning to Bare Metal"*.
 - 1. Sand smooth and re-clean.
 - 2. Spot-prime bare metal surfaces with specified primer applied to a total spot primer DFT of at least 5 mils.
 - 3. Overlap undamaged primer areas with spot primer at least 2 inches.

3.4 PROTECTION

- A. Protect installed primer from deterioration and damage until covering.
- B. Do not store anything on, adjacent to, or against primed surfaces unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use primed surfaces as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 05 05 23 – METAL FASTENINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-structural fastening materials.
2. Non-structural cast-in-place anchors.
3. Non-structural post-installed anchors.
4. Non-structural mechanical fasteners.
5. Delegated design of selected fasteners.
6. Site tests and inspections.
7. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 06 10 53 for non-structural metal fastenings used to fasten wood items together and to join wood items to other materials.

1.2 RELATED DOCUMENTS

- ##### A.
- This specification supplements the requirements of other specification sections. Additional fastening requirements specific to a work result are specified within the applicable specification sections.

1.3 REFERENCES

A. Abbreviations and Acronyms:

1. ACI: American Concrete Institute.
2. AWS: American Welding Society.
3. HDG: Hot-Dip Galvanized.
4. UTS: Unified Thread Standard.
5. UNC: Unified Coarse Thread Series.
6. UNF: Unified Fine Thread Series.

B. Definitions:

1. Manufacturer: Means the fastening manufacturer, unless otherwise indicated.

2. Bolt: Means a threaded fastener 1/4-inch or larger in diameter that is designed to be used either with nuts or in tapped holes.
3. Post-Installed Anchor: Means anchor elements designed for transferring tension and shear loads to structural concrete or masonry elements and installed in pre-drilled holes in the substrate.
4. Screw: Means a threaded fastener less than 1/4-inch in diameter.
 - a. Machine Screw: Means a screw that that is designed to be used either with nuts or in tapped holes.
 - b. Thread Cutting/Thread Forming (Hi-Lo) Screw: Means a screw with a tapered shaft that is designed to be used in un-threaded substrates.
5. Stud: Means a threaded rod.
6. Structural: Means the components of building systems, including roof/ceiling assemblies, parapets, lintels, floor/ceiling assemblies, girders, beams, columns, axial-load-bearing walls, and foundations, designed to transfer or distribute building loads, including snow, rain, wind, live, dead, seismic, earth, and flood loads to ground.
7. Thread: Means the thread form and series in conformance with the following UTS designations.

Size Designation	Shank Diameter (inch)	Threads per Inch (UNC)	Threads per Inch (UNF)
#0	0.060	-	80
#1	0.730	64	72
#2	0.086	56	64
#3	0.099	48	56
#4	0.112	40	48
#5	0.125	40	44
#6	0.138	32	40
#8	0.164	32	36
#10	0.190	24	32
#12	0.216	24	28
1/4-inch	0.250	20	28
5/16-inch	0.3125	18	24
3/8-inch	0.375	16	24
7/16-inch	0.4375	14	20
1/2-inch	0.500	13	20
9/16-inch	0.5625	12	18
5/8-inch	0.625	11	18
3/4-inch	0.750	10	16

Size Designation	Shank Diameter (inch)	Threads per Inch (UNC)	Threads per Inch (UNF)
7/8-inch	0.875	9	14
One-inch	1.000	8	12

1.4 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design:

1. Select and install fastenings that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and results in structurally sound, and non-corroding attachments that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
2. Maintain visual design concept indicated, including profiles and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.

B. Coordination: Provide fasteners and accessory materials suitable to the type of use and conditions of installation and service indicated; and as required for producing secure attachment to supporting construction without staining or deterioration of either the base materials or fastened materials; or deterioration of the fastener itself when in contact with base materials or fastened materials.

1. Verify fasteners are made of the same material as the fastened material or have a suitable barrier protection coating.
 - a. Apply corrosion-inhibiting material (e.g., pastes, washers, compounds, etc.) under the heads of screws or bolts inserted into dissimilar metal, even if they already have been treated or have a protective coating.
 - b. Washers, gaskets, and sleeves must be made of plastic or closed-cell polychloroprene (Neoprene).
2. Provide fasteners and accessories that are galvanically compatible with fastened materials under conditions of installation and service, as demonstrated by the fastener manufacturer based on testing and field experience. Do not use fasteners that are corrosive or otherwise incompatible with fastened materials.
3. Where fasteners are subject to loosening or turning out due to thermal and structural movements, wind loads, vibration, and other causes, provide self-locking devices that either maintain tension in the fastener assembly or remain locked even if tension in the assembly is lost. (e.g. washers, locknuts, and similar items)
4. Unless otherwise indicated or unavoidable, provide concealed fasteners for interconnecting components and for attaching and fastening work to adjacent construction. Where unavoidable, provide flat head cap screws (type FHCS) with drive slots filled and finished flush and smooth with adjacent surfaces.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submittal requirements for fastenings specific to a work result are specified within the applicable specification sections.
 - 2. Samples: When requested by the Architect, submit full-size samples of each selected metal fastener.
- B. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 QUALITY ASSURANCE

- A. Quality Standard: Post-installed anchors in concrete must conform to the requirements of ACI publication ACI 355.2 *"Qualification of Post-Installed Mechanical Anchors in Concrete"*.

1.7 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor and from deterioration and damage.
 - 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or

other sources of deterioration and damage, including dust and other airborne contaminants.

- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective fasteners with undamaged new fasteners that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

D. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 SOLDERING AND WELDING MATERIALS

A. Soldering Materials:

1. HDG Sheet Metal Solder and Flux: 50-percent tin solder conforming to ASTM B 32 Grade Sn50 and used with a non-corrosive flux.
2. Stainless Steel Sheet Metal Solder and Flux: 60-percent tin solder conforming to ASTM B 32 Grade Sn60 and used with an acid flux.

B. Welding Materials:

1. Electrodes: Provide electrodes appropriate for the type and grade of metal being welded and the conditions of installation, use, and service. Welding rods and bare electrodes must conform to AWS specifications based on
 - a. physical properties of weld metal;
 - b. type of coating on electrode;
 - c. welding position of electrode; and
 - d. type of welding current used with electrode.
2. Filler Metal: Provide filler metal and electrode type and alloy recommended or accepted by the producer of the metal being welded, and as required for strength, corrosion resistance, and compatibility with fabricated items under the conditions of installation and service.

2.3 MECHANICAL FASTENER MATERIALS

- A. Uncoated Carbon Steel Mechanical Fastener Material:
 - 1. Screws: Manufactured from carbon steel wire rods and uncoated coarse round wire conforming to ASTM A 510, Grades 1018 to 1022.
 - 2. Bolts: ASTM A 307, Grade A.
 - 3. Nuts and Flat Washers: ASTM A 563, Grade C3.
- B. Uncoated Stainless Steel Mechanical Fastener Material:
 - 1. Description: Austenitic stainless-steel screws, bolts, and studs conforming to ASTM F 593 and nuts conforming to ASTM F 594 requirements for Alloy Group 1 (304 Series) or Alloy Group 2 (316 Series).
 - 2. Performance Requirements:
 - a. Type 304: No sign of surface red rust after at least 1,000 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
 - b. Type 316: No sign of surface red rust after at least 1,500 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- C. Uncoated Nonferrous Metal Mechanical Fastener Material:
 - 1. Copper, brass, bronze, nickel, aluminum, and titanium nuts conforming to ASTM F 467 and commercial wrought bolts, hex cap screws, and studs conforming to ASTM F 468.
 - 2. Provide alloy and temper suitable for the intended use and in-service loads, environmental exposure, and other conditions as required, recommended, or accepted by the manufacturer.
- D. Uncoated Bi-Metal Mechanical Fastener Material:
 - 1. Description: Fasteners having a fused stainless steel head and shank and hardened steel drill point.
 - 2. Product: "Bi-Flex" fasteners manufactured by Elco Construction Products, or equal.
 - 3. Performance Requirements: No sign of surface red rust after at least 800 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- E. Coated and Plated Mechanical Fastener Material:
 - 1. Corrosion protective fastener coatings and platings must be deposited in conformance with the following.
 - a. Phosphate/Oil and Phosphate/Organic Coatings: ASTM F 1137.
 - b. Electrodeposited Coatings on Threaded Fasteners: ASTM F 1941.
 - 2. To verify the prevention of internal hydrogen embrittlement (IHE) in steel fasteners during surface preparation, pretreatment, and plating or coating, all plating or coating processes must be periodically audited in conformance with ASTM F 1940. New or revised plating or coating processes must also be qualified by ASTM F 1940.

3. Plated fasteners with a hardness value of Rockwell 32 and higher must be baked promptly after plating at between 375 and 400 deg. F for at least 3 to 24 hours (depending on plating type and thickness) to neutralize hydrogen embrittlement. Baking must occur before chromating, and before application of subsequent coatings.
- F. HDG Steel Mechanical Fastener Material:
1. Description: HDG carbon steel fasteners having zinc coating conforming to
 - a. ASTM A 153 minimum coating weight requirements for Class C materials (fasteners over 3/8-inch diameter and similar articles; washers 3/16-inch and 1/4-inch thick) or Class D materials (fasteners 3/8-inch diameter and under, rivets, nails, and similar articles; washers under 3/16-inch thick); and
 - b. ASTM F 2329 for coating of threaded fasteners and washers.
 2. Performance Requirements: No sign of surface red rust after at least 32 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- G. Zinc-Plated Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having electrodeposited zinc coating conforming to ASTM B 633, thickness Class Fe/Zn 5, Type I finish.(as-plated without supplementary treatment)
 2. Requisite Properties:
 - a. Sacrificial Coating: 5- to 8-micron (0.0002- to 0.0003-inch) electrolytically-deposited zinc plating.
 - b. Passivate: None.
 3. Performance Requirements: No sign of surface red rust after at least 32 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- H. Clear Chromate Finish Zinc-Plated Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having electrodeposited zinc coating conforming to ASTM B 633, Thickness Class Fe/Zn 8, Type III supplementary finish. (clear chromate conversion coating)
 2. Requisite Properties:
 - a. Sacrificial Coating: 8- to 12-micron (0.0003- to 0.0005-inch) electrolytically deposited zinc plating.
 - b. Passivate: Restriction of Hazardous Substances Directive (RoHS)-compliant clear trivalent chromate conversion coating. Hexavalent chromium conversion coatings are prohibited.
 3. Performance Requirements: No sign of surface red rust after at least 48 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- I. Pigmented Chromate Finish Zinc-Plated Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having electrodeposited zinc coating conforming to ASTM B 633, Thickness Class Fe/Zn 25, Type II supplementary finish (color chromate conversion coating).

2. Requisite Properties:
 - a. Sacrificial Coating: At least a 25-micron (0.00098-inch) electrolytically deposited zinc plating.
 - b. Passivate: Restriction of Hazardous Substances Directive (RoHS)-compliant trivalent chromate conversion coating having a green dye added to the clear tri-chrome bath or applied following the clear dip. Hexavalent chromium conversion coatings are prohibited.
 3. Performance Requirements: No sign of surface red rust after at least 48 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- J. Phosphate Coated Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having corrosion-resistant zinc phosphate coating applied by the immersion bath method.
 2. Performance Requirements: No sign of surface red rust after at least 240 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- K. Polymer-Coated Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having a fluoropolymer or Xylan coating that provides barrier protection against galvanic action.
 2. Barrier Coating: At least a 25-micron (0.00098-inch) electrolytically deposited zinc plating.
 3. Performance Requirements: No sign of surface red rust after at least 500 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- L. Baked Inorganic-Coated Steel Mechanical Fastener Material (e.g., Geomet, Dacromet, or equal):
1. Description: Carbon steel fasteners having a VOC-compliant, water-based, non-chrome (NC), nickel-, cadmium-, lead-, barium-, and mercury-free dispersion coating conforming to ASTM F 1136 containing metal oxides, metallic zinc, and aluminum flakes that becomes inorganic after curing.
 2. Barrier Coating: At least an 8-micron (0.00098-inch) dip-spin and convection oven-cured coating.
 3. Performance Requirements: No sign of surface red rust after at least 500 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- M. Duplex Coated Anti-Corrosive Steel Mechanical Fastener Material:
1. Description: Carbon steel fasteners having a 2-coat finish that combines the sacrificial protection of steel base metal with the barrier protection of a polymer topcoat.
 2. Requisite Properties:
 - a. Basecoat: Inorganic zinc-rich coating.

- b. Topcoat: Aluminum-rich, thermosetting epoxy resin (e.g., Magnigard, or equal); polyester resin (e.g., Climaseal, or equal); or fluoropolymer resin (e.g., Stalgard, FluoroKote#1, or equal).
 3. Performance Requirements: No sign of surface red rust after at least 800 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- N. 3-Coat Anti-Corrosive Steel Mechanical Fastener Material:
 1. Description: Carbon steel fasteners having a 3-coat finish that combines the sacrificial protection of steel base metal with the barrier protection of a polymer topcoat.
 2. Requisite Properties:
 - a. Basecoat: Mechanically deposited zinc-alloy coating (coating is applied by mechanically tumbling zinc and tin powder with the base metal and non-metallic impact beads).
 - b. Intermediate Coat: Chromate conversion coating.
 - c. Topcoat: Aluminum-filled thermosetting polyester resin.
 3. Performance Requirements: No sign of surface red rust after at least 800 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
- O. Ceramic-Coated Anti-Corrosive Steel Mechanical Fastener Material:
 1. Description: Carbon steel fasteners having 3-coat finish that provides electrolytic corrosion protection by combining zinc sacrificial protection with ceramic topcoat barrier protection; and having a current evaluation report from the ICC-ES demonstrating code compliance.
 2. Application: Use ceramic-coated anti-corrosive steel fasteners
 - a. with pressure treated wood, including alkaline copper quaternary (ACQ), ammoniacal copper arsenate (ACA), chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), copper azole (CBA-A and CA-B), copper citrate (CC), and disodium octaborate tetrahydrate (DOT);
 - b. when attaching to exotic hardwood lumber base material;
 - c. with composite lumber; and
 - d. when attaching cement board, high-density exterior sheathing, and tile backer board to framing members at exterior walls, at high-moisture interior walls, and in high-corrosion environments.
 3. Product: "Grabber" screws manufactured by Grabber Construction Products, or equal.
 4. Requisite Properties:
 - a. Basecoat An 8- to 10-micron (0.0003- to 0.0004-inch) mechanically deposited zinc-alloy coating.
 - b. Intermediate Coat: Chromate conversion coating.
 - c. Topcoat: Corrosion-resistant baked ceramic surface coating.

5. Performance Requirements: No sign of surface red rust after at least 1,000 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.

2.4 CAST-IN-PLACE ANCHORS

- A. Description: Threaded steel anchor bolts (anchor rods) with hot-dip zinc coating conforming to ASTM F 1554 Grade 36 or weldable Grade 55, having Class 2A threads before zinc coating (non-headed anchor bolts, either bent or straight, having properties conforming to ASTM A 36, tensile strength of between 58 and 80 ksi, and intended for structural anchorage purposes) with hex-head nuts and flat washers conforming to ASTM A 563 chemical requirements for Grade A nuts.
- B. Requisite Properties:
 1. Size: Provide bolt or stud sizes required by engineering calculations for type of use indicated (between 1/4-inch and 4 inches).
 2. Coating: Hot-dip galvanize anchors, nuts, and washers in conformance with ASTM A 153 minimum zinc coating weight requirements for Class C materials.

2.5 POST-INSTALLED ANCHORS

- A. Description: ICC-ES-approved anchors conforming to California Building Code Category 1, Seismic Zones A-F.
- B. Manufacturer: Provide products manufactured by Hilti, Inc., or equal.
- C. Torque-Controlled Expansion Anchors:
 1. Description: Anchors actuated by tightening a bolt or nut. Expansion anchors installed in concrete must further conform to the requirements of ACI 355.2, Commercial Item Description A-A-1923A Type 4, and ACI-318 Appendix D.
 2. Product: "KB-TZ SS304" manufactured by Hilti, Inc. (ICC-ES Report ESR-1917), or equal.
 3. Performance Requirements: Expansion anchors must be rated to sustain without failure a load equal to at least 4 times the design load when installed in concrete; and at least 6 times the design load when installed in unit masonry, when tested in conformance with ASTM E 488.
- D. Displacement-Controlled Expansion Anchors (Drop-In Anchors): Prohibited.
- E. Power-Actuated Fasteners:
 1. Description: Provide powder-actuated, pneumatic, or gas-powered direct fastening system for driving fasteners into concrete, CMU, and steel.
 2. Restrictions:
 - a. Power actuated-fasteners may not be used in concrete for sustained tension loads or for brace applications unless explicitly designed for seismic loading; except when used for support of acoustical tile or lay-in panel suspended ceiling

applications and distributed systems where the service load on any individual fastener 90 pounds or less.

- b. Power actuated fasteners may not be used in CMU unless explicitly designed for seismic loading.
- c. Power actuated-fasteners may not be used in steel for sustained tension loads or for brace applications unless explicitly designed for seismic loading; except where the service load on any individual fastener is 250 pounds or less.

2.6 MECHANICAL FASTENERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Elco. (ICC-ES Report No. ESR-3332)
 - 2. Grabber Construction Products. (ICC-ES Report No. ESR-5280)
 - 3. Hilti, Inc. (ICC-ES Report No. ESR-2196)
 - 4. ITW Buildex. (ICC-ES Report No. ESR-3270)
 - 5. PrimeSource Building Products, Inc. (ICC-ES Report No. ESR-1408)
- B. Screw Fasteners:
 - 1. Application: Used for attaching to cold-formed or lightgage steel framing.
 - a. Fastening Together Cold-Formed or Lightgage Steel Members: ASTM C 1513.
 - b. Fastening Gypsum Panel Products, Metal Plaster Bases, Cementitious Backing Board and Cement Board to Cold-Formed Metal Framing: ASTM C 954.
 - c. Fastening Gypsum Panel Products and Metal Plaster Bases to Lightgage Metal Framing: ASTM C 1002, Type S.
 - d. Fastening Gypsum Panel Products and Metal Plaster Bases to Lightgage Metal Framing: ASTM C 1002, Type G.
 - 2. Requisite Properties:
 - a. Minimum Length: Screw fasteners must penetrate through metal framing with at least 3 exposed threads beyond the substrate.
 - b. Head Style:
 - 1) Provide wafer head screws when fastening together metal framing members and when fastening metal plaster bases to metal framing.
 - 2) Provide bugle head screws when fastening gypsum panels to metal framing.
 - 3) Provide hex washer head screws with ethylene propylene diene monomer (EPDM) bonded sealing washers when fastening sheet metal panels, siding, roofing, flashings and similar items to metal framing. Provide exposed fastener heads with factory-applied coating matching prefinished roof or wall panel color.
 - 4) Fasteners not indicated to be overlaid either with gypsum panels or other substrates or finish materials may have hex washer, pan, pancake, modified truss, or pan framing head types.
 - c. Drive Style: #2 Phillips drive, unless otherwise indicated.
 - d. Point Style:
 - 1) Attaching Cement Board: Hi-Lo type point.

- 2) Attaching Sheet Metal and Lightgauge Metal Framing (up to 30 mils and thinner): Self-piercing point.
 - 3) Attaching Sheet Metal and Cold-Formed Metal Framing (at least 33 mils and thicker): For normal, single-thickness material and multiple material thickness combined for total of between
 - a) 0.035- and 0.110-inch thick: Provide #2 self-drilling point.
 - b) 0.100- and 0.220-inch thick: Provide #3 self-drilling point.
 - c) 0.175- and 0.250-inch thick: Provide #4 self-drilling point.
 - d) 0.250- and 0.375-inch thick: Provide #5 self-drilling point.
- C. Bolts and Nuts:
1. Description: Regular bolts with hex-head nuts and flat washers.
 2. Requisite Properties:
 - a. Fastener Size: Unless otherwise indicated, provide at least 3/4-10 coarse thread bolts or studs in lengths required to provide a minimum thread engagement equal to the thread diameter, with at least one clear thread plus the thread lead (start) above the nut face, and at least one clear thread plus the thread run out beneath the nut face after tightening. Assume one washer will be used under the rotating part (generally the nut) and allow for this when selecting the bolt length.
 - b. Fastener Head Type: Hexagon-head with both the strength and type of steel used in bolt manufacture indicated on the head of the bolt by a raised mark conforming to ASTM bolt designation standards.

2.7 ACCESSORIES

- A. Expansion Shields: Die cast zinc alloy or zinc-coated steel single or double expansion shields manufactured for type of screw fastener indicated, specified, or selected. Lead or zinc and lead expansion shields are prohibited.
- B. Concrete Patching Mortar: Provide one of the following, or equal.
 1. "EMACO S66 CI" manufactured by BASF.
 2. "SikaRepair 223" manufactured by Sika Corp.
- C. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.

- B. Verification: Verify that in-place construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install fastenings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Fasten work tightly to prevent rattle or vibration except where expansion-contraction tolerances are required.
 - 3. Installed fastenings must be warrantable. Do not install, correct, or replace fastenings in a manner that is un-warrantable by the manufacturer; or that results in any warranty or guarantee becoming void.
- B. Screw Fastener Special Techniques:
 - 1. Maintain bit engagement until fastener is completely driven and fastener stops rotating.
 - 2. Install screws flush with surface; do not countersink or over-drive screw fasteners.
- C. Post-Installed Anchor Special Techniques:
 - 1. Examination: Inspect substrates to verify conditions of access, interference, and existing materials.
 - a. Using non-destructive methods, verify locations of reinforcement and post-tensioning tendons in drill locations.
 - b. Use care and caution to avoid cutting or damaging reinforcement.
 - c. Unless otherwise indicated, maintain a clearance of at least 1 inch between tendon sheaths and anchors or dowels.
 - 2. Layout:
 - a. Locations and Spacing: Indicated on the Drawings.
 - b. Edge Distance: At least 10 nominal bolt diameters when installed in concrete.
 - 3. Drilling and Preparing Holes:
 - a. Holes may not be drilled in concrete or into grouted CMU until at least 7 days after concrete is cast or grout is placed; and until concrete or grout achieves its specified design compressive strength.

- b. Unless otherwise indicated, holes must be drilled using the manufacturer's recommended drill type, bit, and setting.
 - c. Hole diameters must conform to manufacturer's instructions; hole depth as indicated on the Drawings.
 - d. Abandon over-drilled holes and fill with specified patching mortar.
 - e. Abandon drilled holes and fill with specified patching mortar when hole deviates more than 5 degrees, measured from a line normal to the concrete surface.
 - f. Promptly notify Architect if concrete reinforcing bars or post-tensioning tendons are encountered during drilling.
 - g. Dust and other contaminants must be completely removed from holes by blowing with compressed air or other effective methods.
- D. Expansion Anchor Special Techniques:
 - 1. Install anchors into pre-drilled and properly-prepared holes in conformance with the manufacturer's installation instructions.
 - 2. Expansion anchor embedment may not be less than required by the manufacturer.
 - a. Embedment length excludes thickness of finish coverings and other overlays.
 - b. When installed overhead into concrete slabs through metal decking, embedment must extend within a zone between 1-1/2 inches above top of flute and 3/4-inch below top of concrete.
 - 3. Tighten anchors to the manufacturer-recommended installation torque values.
- E. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach fastenings to supporting construction.
- F. Installation Tolerances: Install fastenings to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
 - 1. General: Include site tests as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.

- g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
- 2. Required Tests: Perform static tension load tests in conformance with ASTM E 488, *"Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements"* on at least 10 percent of each installed anchor diameter or as indicated on the Drawings.
 - a. Expansion Anchor Testing: Scheduled tests may not be performed less than 24 hours after anchor installation. Scheduled test loads are applied for 2 minutes during which the maximum allowable slip is not more than 1/8-inch.
 - b. Additional Testing: If an anchor fails tension load testing, additional anchors must be tension load tested until at least 20 consecutive successful tests are performed.
 - c. Testing Documentation: The testing and inspection agency develops and implements a clear method of identifying in-service locations and results of anchor tests. Field marking for test locations may not affect the appearance of exposed concrete or CMU. Detailed drawings recording test locations and results are permitted in lieu of field marking.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Corrective and repair work must be inspected by the testing and inspection agency.
 - 1. Remove and replace anchors at failed test locations.
 - 2. When approved by the testing and inspection agency, install replacement anchors or dowels in existing holes. Existing holes not approved by the testing and inspection agency are considered defective work.
 - 3. All replacement anchors must be tension load tested.

- D. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

END OF SECTION

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Structural steel support members.
- C. Base plates, shear stud connectors and expansion joint plates.
- D. Grouting under base plates.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 031000 - Concrete Forming and Accessories.
- C. Section 033000 - Cast-in-Place Concrete.
- D. Section 051213 - Architecturally-Exposed Structural Steel Framing: Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).
- E. Section 052100 - Steel Joist Framing.
- F. Section 053100 - Steel Decking: Support framing for small openings in deck.
- G. Section 055000 - Metal Fabrications: Steel fabrications affecting structural steel work.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. AISC (MAN) - Steel Construction Manual.
 - 2. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges.
 - 3. AISC 341 - Seismic Provisions for Structural Steel Buildings.
 - 4. AISC 360 - Specification for Structural Steel Buildings.
 - 5. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 6. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 7. ASTM A108 - Standard Specification for Steel Bar, Carbon, and Alloy, Cold Finished.

8. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
9. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
10. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel.
11. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
12. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
13. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
14. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
15. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
16. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts [Metric].
17. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
18. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
19. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
20. 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.
21. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
22. ASTM E94/E94M - Standard Guide for Radiographic Examination Using Industrial Radiographic Film.
23. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
24. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry.
25. ASTM E709 - Standard Guide for Magnetic Particle Testing.
26. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
27. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
28. ASTM E94 - Standard Guide for Radiographic Examination.
29. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series.
30. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

31. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 32. AWS D1.1/D1.1M - Structural Welding Code - Steel.
 33. AWS D1.4/D1.4M – Structural Welding Code - Reinforcing Steel.
 34. AWS D1.8/D1.8M - Structural Welding Code - Seismic Supplement.
 35. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc.
 36. SSPC SP-1 - Solvent Cleaning.
 37. SSPC SP-2 - Hand Tool Cleaning.
 38. SSPC SP 3 - Power Tool Cleaning.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
 - a. Chapter 17 - Structural Tests and Inspections.
 - b. Chapter 22 - Steel.
- C. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
1. ICC ES Evaluation Reports, Materials, Products, Methods and Types of Construction, with current report (ESR).
- D. International Association of Plumbing and Mechanical Officials (IAPMO):
1. UES Evaluation Service Reports (IAMPO R&T).
- E. Research Council on Structural Connections
1. Specification for Structural Joints Using High-Strength Bolts.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - a. Individual items of structural steel shall be cross-referenced by grid location.
 2. Indicate cambers.
 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths. Indicate shop or field welds.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
1. Submit Charpy-V-Notch (CVN) Impact Test results from the manufacturer for applicable steel members and components.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Fabricator Test Reports: Comply with ASTM A1011/A1011M.

- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- G. Fabricator's Qualification Statement.
- H. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172 or AISC Certified Fabricator.
- I. Welding Procedures:
 - 1. Submit welding procedures, indicating joint details and tolerances, preheat and interpass temperature, post heat treatment, single or multiple pass, electrode type and size, welding current, polarity, and amperes and roof treatment.
 - a. Project CWI shall review WPS and PQRs (if applicable) prior to submittal to the Architect.
 - 2. Welding procedures shall comply with the requirements of AWS D1.1, and it shall include the welding parameters recommended by the welding electrode manufacturer.
 - 3. Refer to Structural Contract Drawings for weld testing and inspection.
 - 4. Submit Charpy-V-Notch (CVN) Impact Test results from the manufacturer for applicable welds.
- J. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual and AISC 303 - Code of Standard Practice.
- B. Structural steel members designated as architecturally-exposed structural steel (AESS) to also comply with Section 051213.
- C. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

- D. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172 and Certified by AISC or City of Los Angeles.
- E. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
 - 1. Licensed, certified, or otherwise approved in writing by the accepted fabricator.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. A. Storage: Protect steel members that will be stored on site for a prolonged period to protect from adverse effects of exposure to weather.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria

1. VOC content criteria
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MATERIALS

- A. Steel Angles and Channels: As specified in contract drawings.
- B. Steel W Shapes and Tees: As specified in contract drawings.
- C. Rolled Steel Structural Shapes: As specified in contract drawings.
- D. Steel Plates: As specified in contract drawings.
- E. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- F. Steel Sheet: ASTM A1011/A1011M, Designation SS, Grade 30 hot-rolled, or ASTM A1008/A1008M, Designation SS, Grade 30 cold-rolled.
- G. Pipe: As specified in contract drawings.
- H. Shear Stud Connectors: As specified in contract drawings.

- I. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
- J. High-Strength Structural Bolts, Nuts, and Washers: As specified in contract drawings.
- K. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
- L. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
- M. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- N. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength as indicated in structural drawings.
 - 2. Minimum Compressive Strength at 28 Days: 8,000 pounds per square inch.
- O. Adhesive Anchoring Systems: As indicated in contract drawings.
- P. Expansion Anchors: As indicated in contract drawings.
- Q. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- R. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

- A. Fabricate structural steel in accordance with the AISC Specification and CBC Chapter 22. Do not start fabrication until mill test reports have been accepted by Architect.
- B. Shop fabricate to greatest extent possible.
- C. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
- D. Holes shall be standard hole diameter, unless noted otherwise.
 - 1. Holes for anchor bolts cast in concrete may be oversized in accordance with AISC Manual. Provide washer as indicated.
- E. Welded Connections: Refer to Structural Contract Drawings for welding requirements.
 - 1. Make welded connections in accordance with AWS D1.1 and D1.8.

- F. Headed Welded Studs: Prepare steel surfaces as recommended by the manufacturer of the shear connectors. Shop or field-weld headed welded studs, spaced as indicated, to beams and columns. Use automatic end welding of headed stud shear connectors in accordance with the manufacturer's printed instructions. Provide complete fusion between end of the stud and the member without porosity or evidence of lack of fusion.
- G. Galvanizing: Hot dip galvanize ferrous metal in accordance with ASTM A 123. Hot dip galvanize exterior ferrous steel. Perform galvanizing after fabrication (shearing, punching, bending, forming, assembling, and welding) in the largest units practicable. Remove projections, barbs, and icicles after galvanizing.

2.4 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
- C. Prepare and paint steel as indicated in contract drawings and in conformance with 099100 - Painting and 099713 - High Performance Steel Coatings

2.5 SOURCE QUALITY CONTROL

- A. No structural steel materials may be used, fabricated, or furnished until written acceptance of quality control submittals is issued by the code enforcement agency.
 - 1. Conduct a thorough material ID and mill certification review for steel products.
 - 2. Provide identifiable steel per CBC 2202.
 - a. Unidentifiable steel shall not be permitted for use.
- B. Conform to the inspection requirements of CBC Chapter 17 and the testing requirements of CBC 2204:
 - 1. Special inspection of Structural Welding and bolting shall be per CBC 1705.2.
 - a. Inspection of shop and field welding operations shall be made by a qualified welding inspector approved by the enforcement agency. The minimum requirements for a qualified welding inspector shall be as those for an AWS certified welding inspector (CWI), as defined in the provisions of the AWS QC1. All welding inspectors shall be as approved by the enforcement agency.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

- A. Erect structural steel in compliance with AISC 303 and AISC 360.
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
 - 1. Level and plumb individual members of structure within specified AISC tolerances.
- C. Splice members only where indicated and accepted on final shop drawings.
- D. Do not enlarge holes in members by burning or by use of drift pins except in secondary bracing members. Ream holes that must be enlarged to accept bolts.
- E. Back-up bars, dams, and runoff tabs shall be removed: the weld, base metal shall be ground flush and smooth per AWS.
- F. High-Strength Steel Bolting: Perform in accordance with the AISC 303, AISC 36, and in accordance CBC Chapter 22.
 - 1. Materials, method of installation and tension control, type of wrenches to be used, and inspection methods shall conform to ASTM F3125.
- G. Do not field cut or alter structural members without approval of Architect.
 - 1. Gas Cutting: Do not use gas cutting torches in field for correction in fabrication. Cutting will be permitted only on secondary members which are not under stress. Finish gas-cuts sections equal to a sheared appearance when permitted.
 - 2. Cutting of Holes: Field cutting of holes shall be made by drilling only. Burning of holes will not be permitted.
- H. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- I. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.3 TOLERANCES

- A. Steel members and erection shall conform with requirements of AISC 303 and AISC 360.

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

END OF SECTION 051200

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SECTION 051213 - ARCHITECTURALLY-EXPOSED STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Additional requirements for structural steel members designated as architecturally-exposed structural steel (AESS).

1.2 RELATED REQUIREMENTS

- A. Section 051200 - Structural Steel Framing: General requirements for structural steel members, including AESS framing specified in this section.

1.3 DEFINITIONS

- A. Architecturally-Exposed Structural Steel: Structural steel complying with designated AESS category as defined in AISC 303.

1.4 REFERENCE STANDARDS

- A. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.
- B. AISC 360 - Specification for Structural Steel Buildings; 2010.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2014.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- H. ASTM A1085/A1085M - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS); 2015.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).

- K. SSPC-SP 1 - Solvent Cleaning; 2015.
- L. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Schedule and conduct a preinstallation meeting at project site one week prior to start of work of this section; require attendance by all affected installers. Coordinate requirements for shipping, special handling, storage, attachment of safety cables and temporary erection bracing, final coating, touch-up painting, mock-up coordination, Architect's observations, and other requirements for AESS.
- B. Steel members and connections exposed to view shall be AESS 3 per AISC 303-16.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product data for each type of product specified. Submit paint systems in accordance with Section 099113.
- C. Shop Drawings: Detailing for fabrication of AESS components.
 - 1. Provide erection documents clearly indicating which members are AESS members and the AESS category of each part.
 - 2. Include details that clearly identify AESS requirements found in this specification. Provide connections for AESS consistent with concepts shown on drawings.
 - 3. Indicate welds by AWS A2.4 symbols, distinguishing between shop and field welds, and show size, length and type of each weld. Identify grinding, finish and profile of welds as defined by the designated AESS category.
 - 4. Indicate orientation of hollow structural section (HSS) seams and mill marks (where applicable).
- D. AESS 2 and AESS 3 Samples: Provide samples of specific AESS characteristics. Samples may be small size samples or components of conventional structural steel demonstrating specific AESS characteristics, including surface preparation, sharp edges ground smooth, continuous weld appearance, weld show through, and fabrication mark removal.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: In addition to those qualifications listed in Section 051200, engage an AISC Certified Fabricator, experienced in fabricating AESS similar to that indicated for this project with a record of successful in-service performance, as well as sufficient production capacity to fabricate AESS without delaying the work.

- B. Erector Qualifications: In addition to those qualifications listed in Section 051200, engage an AISC Certified Erector, experienced in erecting AESS work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.
- C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work..
- D. Comply with applicable provisions of AISC 303, Section 10 for the designated AESS category.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handle finished pieces in accordance with Section 10 of AISC 303, using nylon-type slings, or chains with softeners, or wire ropes with softeners such that they are not damaged.
- B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration. Use special care in handling to prevent twisting or warping of AESS members.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Comply with Section 051200, except as amended in this section for aesthetic purposes.

2.2 FABRICATION

- A. Fabricate and assemble AESS in shop to greatest extent possible. Locate field joints in AESS assemblies at concealed locations or as approved by Architect. Detail AESS assemblies to minimize field handling and expedite erection.
- B. Permissible tolerances for member depth, width, out of square, and camber and sweep to be as specified in ASTM A6/A6M, ASTM A500/A500M, and ASTM A1085/A1085M.
- C. Use special care in handling and shipping of AESS both before and after shop painting to minimize damage to any shop finish. Use nylon-type slings or softeners when using chains or wire rope slings.
- D. Bolted Connections:
 - 1. Make in accordance with Section 051200. Provide bolt type and finish as noted herein.
- E. Welded Connections:
 - 1. Comply with AWS D1.1/D1.1M and Section 051200.

F. Surface Preparation:

1. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
2. Remove backing and run out tabs.

G. Fabricate AECS in accordance with categories defined in AISC 303, as follows:

1. AECS 1: Basic elements.
2. AECS 2: Feature elements viewed at a distance greater than 20 feet (feature elements not in close view).
3. AECS 3: Feature elements viewed at a distance less than 20 feet (feature elements in close view).

2.3 PAINT SYSTEM

- A. Compatibility: All components/procedures of AECS paint system to comply with coating system specified, submitted, and approved per Section 099713. As a minimum, identify required surface preparation, primer, intermediate coat (if applicable), and finish coat. Primer, intermediate coating, and finish coating to be from a single manufacturer combined in a system documented by manufacturer with adequate guidance for fabricator to procure and execute.
- B. Primer: As specified in Section 099713. Primer to comply with all federal standards for VOC, lead and chromate levels.

2.4 SHOP PRIMING

A. Surface Preparation:

1. Provide surface preparations to meet SSPC-SP 6.
2. Coordinate required surface profile with approved paint submittal prior to beginning surface preparation.
3. Prior to blasting, remove any grease and oil using solvent cleaning to meet SSPC-SP 1.
4. Remove weld spatter, slivers and similar surface discontinuities.
5. Ease sharp corners resulting from shearing, flame cutting or grinding.

- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted with slip-critical connections.

2.5 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by hot-dip process to AECS indicated for galvanizing according to ASTM A123/A123M. Fabricate such that all connections of assemblies are made in the field with bolted connections where possible.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Erector to check all AESS members upon delivery for twist, kinks, gouges or other imperfections which may result in rejection of appearance of member. Coordinate remedial action with fabricator prior to erecting steel.

3.2 PREPARATION

- A. Provide connections for temporary shoring, bracing and supports only where noted on approved fabrication documents. Temporary connections not shown are to be made at locations not exposed to view in final structure or as approved by Architect.
- B. Handle, lift and align pieces using nylon straps or chains with softeners required to maintain appearance of AESS through process of erection.

3.3 ERECTION

- A. AESS 1 and 2: Basic elements; feature elements not in close view:
 - 1. Employ special care to handle and erect AESS. Erect finished pieces using nylon straps or chains with softeners such that they are not damaged.
 - 2. Place weld tabs for temporary bracing and safety cabling at points concealed from view in completed structure or where approved by Architect during pre-installation meeting. Obtain Architect approval of methods for removing temporary devices and finishing AESS members prior to erection.
 - 3. AESS Erection Tolerances: Erect to standard frame tolerances for structural steel per Chapter 7 of AISC 303.
 - 4. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 5. Remove blemishes or unsightly surfaces resulting from temporary braces or fixtures.
 - 6. Remove all backing and run out tabs.
 - 7. When temporary braces or fixtures are required to facilitate erection, take care to avoid any blemishes, holes or unsightly surfaces resulting from use or removal of such temporary elements.
 - 8. Bolted Connections: Align bolt heads on same side of connection as indicated on approved fabrication or erection documents.
 - 9. Welded Connections: Comply with AWS D1.1/D1.1M and Section 051200. Appearance and quality of welds to be consistent. Employ methods that will maintain alignment of members without warp exceeding tolerance of this section.
 - 10. Remove weld spatter exposed to view.
 - 11. Grind off projections larger than 1/16 inch at field butt and plug welds.
 - 12. Continuous Welds: Where continuous welding is noted on drawings, provide continuous welds of a uniform size and profile.
 - 13. Do not enlarge holes in members by burning or by using drift pins. Ream holes that must be enlarged to admit bolts. Replace connection plates that are misaligned where holes cannot be aligned with acceptable final appearance.

14. Splice members only where indicated.
15. Obtain permission for any torch cutting or field fabrication from Architect. Finish sections thermally cut during erection to a surface appearance consistent with mock-up.

B. AEES 3: Feature elements in close view:

1. Erect to requirements of AEES 1 and 2 and as follows:
2. Field Welding: Weld profile, quality, and finish to be consistent with mock-ups approved prior to fabrication.
3. Provide a continuous appearance to all welded joints including tack welds. Provide joint filler at intermittent welds.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Structural Requirements:
 1. Comply with quality control requirements per AISC 360, Chapter N and AISC 303, Section 10. Refer to Section 051200 for additional requirements.
 2. Quality assurance agency to review work for compliance with requirements of AISC 360, Chapter N and AISC 303, Section 10.
- C. AEES 1 and 2 Acceptance: Architect to observe AEES in place and determine acceptability based on qualification data and submittals. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.
- D. AEES 3,4, and C Acceptance: Architect to observe AEES in place and determine acceptability based on qualification data and submittals as well as on approved mock- up. Quality assurance agency has no responsibility for enforcing requirements related to aesthetic effect.

3.5 CLEANING

- A. Touch-up Painting: Complete cleaning and touch-up painting of field welds, bolted connections, and abraded areas of shop paint to blend with adjacent surfaces of AEES. Perform touch-up work in accordance with manufacturer's instructions and as specified in Section 099100.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas. Repair galvanized surfaces in accordance with ASTM A780/A780M.
- C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION 051213

SECTION 053100 - STEEL DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustical floor deck.
- B. Roof deck.
- C. Composite floor deck.
- D. Supplementary framing for openings up to and including 18 inches.
- E. Bearing plates and angles.
- F. Stud shear connectors.
- G. Acoustical insulation in floor deck flutes.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 031000 - Concrete Forming and Accessories.
- C. Section 032000 - Concrete Reinforcing.
- D. Section 033000 - Cast-in-Place Concrete.
- E. Section 051200 - Structural Steel Framing
- F. Section 052100 - Steel Joist Framing
- G. Section 055000 - Metal Fabrications

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A108 - Standard Specification for Steel Bar, Carbon, and Alloy, Cold Finished.
 - 3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 5. A 924-17 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 7. AWS D1.1/D1.1M - Structural Welding Code - Steel.
 8. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
 9. ICC-ES AC43 - Acceptance Criteria for Steel Deck Roof and Floor Systems.
 10. SDI COSP - SDI Code of Standard Practice for Steel Deck.
 11. SDI SD - Standard for Steel Deck.
 12. SDI QA/QC - Standard for Quality Control and Quality Assurance for Installation of Steel Deck.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
- C. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.
- D. International Association of Plumbing and Mechanical Officials (IAPMO):
1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods, and Types of Construction with current report conforming to the applicable building code.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, span direction, number of spans, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- D. Submit manufacturer's installation instructions.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.
- F. Sustainable Design Submittals
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.

2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Currently a member in good standing of the Steel Deck Institute (SDI) or having a demonstrated capability of manufacturing steel structural decking in accordance with SDI standards.
- B. Installer's Qualifications: Regularly engaged and specializing, for the preceding 5 years, in the installation of steel structural decking systems.
 1. Specifically trained, licensed, certified, or otherwise approved in writing by the deck unit manufacturer.
- C. Welders' Qualifications: Currently certified in accordance with the requirements of AWS D1.3.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.
- C. Do not over-load structure with material stored in concentrated areas.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria
1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria
1. VOC content criteria
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

A. Steel Deck:

1. Vercor Decking Inc.: www.vercodeck.com
2. Nucor-Vulcraft Group: www.vulcraft.com/#sle.
3. ASC Steel Deck, a division of ASC Profiles, Inc., www.ascsd.com.

2.3 STEEL DECK

- A. Steel decks shall be in conformance with SDI Standards and have a current evaluation report (ICC or IAPMO).
- B. Vented Decks: Deck units with concrete fill at areas to receive waterproofing membranes, roofing, elastomeric coatings, and other impermeable membranes shall be vented type.
1. Do not use vent tabs openings to support mechanical equipment.
- C. Fabricate deck units lengths to span two or more bays where possible. Where deck cannot span two or more bays, submit location for review and acceptance by Architect.
- D. Acoustical Deck: Non-composite type:
- E. Metal Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: As specified in drawings.
 2. Structural Properties: As specified in drawings.
- F. Composite Deck: Fluted steel sheet embossed to interlock with concrete:
1. Galvanized Steel Sheet: As specified in drawings.
 2. Structural Properties: As specified in drawings.
- G. Acoustical Composite Deck: Composite type, fluted steel sheet embossed to interlock with concrete:
1. Galvanized Steel Sheet: As specified in drawings.
 2. Provide cellular deck type as indicated in drawings.
 3. Structural Properties: As specified in drawings.
 4. NRC Rating: 0.95 Min.

2.4 ACCESSORY MATERIALS

- A. Bearing Angles: ASTM A36/A36M steel.
- B. Stud Shear Connectors: Per section 051200 - Structural Steel Framing.
- C. Welding Materials: Comply with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
- D. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft density; profiled to suit deck.

2.5 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal wet concrete stops and cover plates shall be of same thickness as deck as indicated; finished same as deck.
- B. Fabricate metal closure strips, for openings between decking and other construction, of not less than 12 gage sheet steel, unless otherwise indicated in drawings. Form to provide tight fitting closures at open ends of cells or flutes and sides of decking. Galvanization shall match the deck.
- C. Roof Drain Pans: As indicated in drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Erect metal deck in accordance with SDI Standards and Manufacturer requirements.
- B. Place deck units in straight alignment for entire length of run of cells and with close alignment between cells at ends of abutting units.
- C. Place deck units flat and square, secured to adjacent framing with-out warp or excessive deflection.
- D. On concrete and masonry surfaces provide minimum 4 inch bearing.
- E. On steel supports provide minimum 2" bearing or as required by manufacturer, whichever is larger.
- F. Locate deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.
- G. Connect deck to steel support members at ends and intermediate supports, parallel with the deck flute and at each transverse flute as specified in drawings.
- H. Shore deck during concrete placement as required by manufacturer or drawings.
- I. Weld deck in accordance with AWS D1.3/D1.3M.
- J. Provide framing at deck openings as required on drawings.
 - 1. Provide metal closure pieces and additional reinforcement as required for strength, continuity of decking, and support of adjacent work.
- K. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- L. Weld stud shear connectors through steel deck to structural members below.

1. Welded stud connectors may be used to replace required deck fastening welds on a one-for-one basis.
- M. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

3.2 FIELD QUALITY CONTROL

- A. Provide inspections of metal deck welds and mechanical fasteners per CBC Chapter 17

END OF SECTION 053100

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SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formed steel stud exterior wall and interior wall framing.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements a. Attachment: LEED Product Data Submittal Cover Sheet
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 053100 - Steel Decking.
- C. Section 072100 - Thermal Insulation: Insulation within framing members.
- D. Section 076200 - Sheet Metal Flashing and Trim: Head and sill flashings.
- E. Section 079200 - Joint Sealants.
- F. Section 092116 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.
- G. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.
- H. Section 092236 - Lath.
- I. Section 092400 - Cement Plastering.
- J. Section 095100 - Acoustical Ceilings: Ceiling suspension system.

1.3 REFERENCE STANDARDS

- A. The applicable version of the standards listed below shall be per Chapter 35 of Part 2 of the 2022 edition of the California Building Code (CBC), including addendums and errata. Where the standard is not listed in the CBC, then the most current version of the standard shall be used or as referenced by other standards.
 - 1. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. AISI S200 - North American Standard for Cold-Formed Steel Framing - General Provisions.
 - 3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

4. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 5. A 924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 7. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 8. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories.
 9. ASTM E488 - Test Method for Strength of Anchors in Concrete and Masonry Elements.
 10. ASTM E1190 - Test Methods for Strength of Power-Actuated Fasteners Installed in Structural Members.
 11. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.
 12. AWS D1.1/D1.1M - Structural Welding Code - Steel.
 13. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel.
 14. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.
- B. California Code of Regulations (CCR):
1. CBSC, Title 24, Part 2- California Building Code (CBC), 2022 edition.
 - a. Chapter 17 - Structural Tests and Inspections.
 - b. Chapter 2210 – Cold-Formed Steel
 - c. Chapter 2211 – Cold-Formed Steel Light-Frame Construction.
- C. ICC Evaluation Service, Inc. (ICC ES), a subsidiary corporation of the International Code Council:
1. ICC ES Evaluation Reports (ESR) for Materials, Products, Methods and Types of Construction with current report conforming to the applicable building code.
- D. International Association of Plumbing and Mechanical Officials (IAPMO):
1. IAPMO Uniform Evaluation Service (UES) Report for Materials, Products, Methods and Types of Construction with current report conforming to the applicable building code.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria and limitations.
- C. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .
- D. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.

2. Preference is given to product-specific type III EPDs
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria
1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria
1. VOC content criteria
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Metal Framing:
1. CEMCO: www.cemcosteel.com/#sle.

2. ClarkDietrich: www.clarkdietrich.com/#sle.
3. The Steel Network, Inc: www.SteelNetwork.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Framing Connectors and Accessories:

2.3 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.4 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
1. Gauge and Depth: As indicated on drawings.
 2. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
 3. Provide components fabricated from ASTM A1008/A1008M Designation SS (structural steel).

2.5 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated and Drilled expansion bolts per drawings.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.6 WALL SHEATHING

- A. Gypsum Board Wall Sheathing: See Section 092116.

2.7 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- D. Water-Resistive Barrier: As specified in Section 072500.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.2 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Place studs at 16 inches on center unless noted otherwise; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
- D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- E. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
- F. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- G. Install intermediate studs above and below openings to align with wall stud spacing.
- H. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- I. Attach cross studs to studs for attachment of fixtures anchored to walls.
- J. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- K. Touch-up field welds and damaged galvanized surfaces with primer.

3.3 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

END OF SECTION 054000

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated non-decorative metal items.
2. Dissimilar metal corrosion protection.
3. Delegated design of metal fabrications.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AWS: American Welding Society.
2. DFT: Dry Film Thickness.
3. HDG: Hot-Dip Galvanized.
4. SSPC: The Society for Protective Coatings.

B. Definitions:

1. Manufacturer: Means the grout or bituminous paint manufacturer, as the context admits, unless otherwise indicated.
2. Fabricator: Means the metal fabricator, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design Requirements:

1. Engineer, fabricate, assemble, and install metal fabrications that conform to the profiles indicated and other Contract Document requirements; meets specified performance criteria; and results in structurally sound and non-corroding assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.

B. Performance Requirements:

1. Design Loads: Indicated on the Drawings.
2. Deflection: Not more than 1/8-inch.
3. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
4. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified below.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:

- a. For manufactured items, submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings:

- a. Submit dimensioned plans and elevations drawn to scale and showing metal fabrication layout and types. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
- b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions. Cross-reference details to plans and elevations.
- c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
- d. Show backings, embedments, fasteners, brackets, clips, cleats, straps, mounting devices, and other attachments.
- e. Label each attachment type; indicate manufacturer's product name for each manufactured item.
- f. Indicate base material and finish, fastener material and finish, and material and finish of items being fastened or attached.
- g. Label welds in conformance with the requirements of AWS publication A2.4, *"Standard Symbols for Welding, Brazing, and Nondestructive Examination"*.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.

- a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; analysis of supporting construction, including section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Quality Standard:

1. Design Standard for Galvanized Items: Items indicated as galvanized must be designed and fabricated in conformance with the requirements of AGA publication, *"The Design of Products to be Hot-Dip Galvanized after Fabrication"*, and ASTM A 385. Limit the use of vent and drain holes and locate where they drain by gravity and are concealed from view in the finish work.
2. Welding Standards: Welding procedures must conform to the requirements of the following American Welding Society publications.
 - a. AWS D1.1, *"Structural Welding Code – Steel"*.
 - b. AWS D1.2, *"Structural Welding Code – Aluminum"*.
 - c. AWS D1.3, *"Structural Welding Code – Sheet Steel"*.
 - d. AWS D1.6, *"Structural Welding Code – Stainless Steel"*.
 - e. AWS D1.8, *"Seismic Supplement"*.
 - f. AWS D9.1, *"Sheet Metal Welding"*.
 - g. AWS D10.10, *"Heating Practices For Pipe And Tube"*.

- h. AWS D10.11, "*Root Pass Welding For Pipe*".
- i. AWS D10.12, "*Pipe Welding – Mild Steel*".
- j. AWS D10.18, "*Pipe Welding – Stainless Steel*".
- k. AWS D11.2, "*Welding – Cast Iron*".
- l. AWS D18.2, "*Stainless Steel Tube Discoloration Guide*".
- m. AWS D19.0, "*Welding Zinc Coated Steel*".

B. Qualifications:

- 1. Fabricator: Company or individuals must have at least 10 years' experience fabricating metal fabrications installed on at least 100 previous projects similar to this project in size, material, design, and complexity
- 2. Installer: Company or individuals must have at least 5 years' experience installing metal fabrications for at least 30 previous projects similar to this project in size, material, design, and complexity.
- 3. Welders: Welding personnel and supervisors must comply with the "*Qualification*" requirements of AWS quality standard publications. Only certified welders current in their certification may perform or supervise any welding work.
- 4. Supervisors: Individuals must have at least 7 years' experience installing metal fabrications for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading metal fabrication installers.
- 5. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped. Furnish adequate dunnage and bracing during storage.
 - 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.

4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective metal fabrications with undamaged new metal fabrications that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 IRON

- A. Ductile Iron Castings: ASTM A 536, Grade 70-50-05 or better.

2.3 STEEL

- A. Steel Plate: ASTM A 36 (mild steel).
- B. Uncoated Steel Coil, Sheet, and Strip: Finished cold-rolled steel coil, sheet, and strip conforming to ASTM A 1008, CS Type B (commercial steel), unexposed (interior items) and exposed, temper rolled (exterior items), regular matte finish (40 to 59 AA), mill phosphatized.
- C. HDG Metallic Coated Steel Coil, Sheet, and Strip: ASTM A 653, CS Type B (commercial steel), with equal coating weight on each surface, coating designation indicated below on both surfaces, minimized spangle, chemically treated, oiled, and mill phosphatized.
 1. Natural Finish: At least a G90 minimum coating designation (galvanized), minimized spangle, chemically treated, and oiled.
 2. Painted Finish: At least an A60 minimum coating designation (galvannealed), not chemically treated, not oiled, and mill phosphatized.
- D. Hot-Rolled Steel Rods, Bars, and Shapes: ASTM A 36 (mild steel), merchant quality.

- E. Steel Pipe: ASTM A 53, black pipe, Type and Grade as indicated below, size and weight class, schedule number, or outside diameter indicated and wall thickness as required by engineering calculations for type of use indicated.
 - 1. Type: Provide Type S (Seamless) pipe.
 - 2. Grade: Provide Grade A pipe for cold bending; otherwise provide Grade B pipe.
- F. Steel Tubing:
 - 1. Steel Structural Tubing: ASTM A 500, Grade A, black, round or shaped hot-formed tubing as indicated, outside diameter or dimensions as indicated, and calculated wall thickness as required by engineering calculations for type of use indicated. Provide seamless tubing.
 - 2. Mechanical Tubing: ASTM A 513, black, Type 5 M.D. (mandrel drawn or Drawn over a Mandrel).
- G. Steel Castings: ASTM A 27, Grade 65-35, Class 2 (post-weld heat-treatment not required).
- H. Galvanized Carbon Steel Wire: Soft temper zinc-coated wire conforming to ASTM A 641, minimum Class 4 coating weight.

2.4 STAINLESS STEEL

- A. Stainless Steel Bars, Hot-Rolled or Extruded Shapes: ASTM A 276, Condition T (hardened and tempered at a relatively high temperature), Type 304L (for welded applications) or Type 304 (for all other applications), passivated in conformance with ASTM A 967.
- B. Stainless Steel Pipe: ASTM A 312, Grade TP (pipe), Type 304L (for welded applications) or Type 304 (for all other applications), passivated in conformance with ASTM A 967.
- C. Stainless Steel Coil, Sheet, Strip, Plate, and Flat Bar:
 - 1. Exposed Locations: ASTM A 666 (annealed and tempered), Type 304L (for welded applications) or Type 304 (for all other applications), annealed, No. 4 (soft) temper (hardness not more than Rockwell B-65; can be bent flat upon itself in any direction), passivated in conformance with ASTM A 967.
 - a. Uncoated (Bare) or Natural Finish: No. 2B (bright) finish.
 - b. Painted Finish: No. 2D (matte) finish.
 - 2. Concealed Locations: ASTM A 240 (annealed) Type 304L (for welded applications) or Type 304 (for all other applications), No. 2D (matte) finish, annealed, No. 4 (soft) temper (hardness not more than Rockwell B-65; can be bent flat upon itself in any direction), passivated in conformance with ASTM A 967.
- D. Stainless Steel Tubing: ASTM A 554, Grade MT (tubing), Type 304L (for welded applications) or Type 304 (for all other applications), No. 2D (matte) finish, passivated in conformance with ASTM A 967.
- E. Stainless Steel Castings: ASTM A 743, Grade CF8M or CF3M.

2.5 ALUMINUM

- A. General: Unless otherwise indicated, provide aluminum alloy and temper recommended by both the metal producer for the type of use, strength, and welding characteristics; and by the aluminum finisher for color match and compatibility of fabricated items with specified finish.
- B. Cold-Rolled Aluminum Bar and Rod: ASTM B 211.
- C. Extruded Bars, Shapes and Tubes:
 - 1. Standard Structural Profiles: ASTM B 308, Alloy 6061-T6.
 - 2. Extruded Aluminum Bars and Shapes: ASTM B 221.
 - a. Alloy and Temper: 6063-T5 or T6 for primary components; 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
 - b. Minimum Thickness: At least 0.125-inch.
- D. Sheet and Plate: ASTM B 209.
 - 1. Alloy and Temper: 5005-H32 (for anodic finishing), or alloy 3003-H14 (for painted or unfinished sheet).
 - 2. Minimum Thickness: At least 0.060-inch.
- E. Aluminum Pipe:
 - 1. Structural Aluminum Pipe and Round Tube: ASTM B 429.
 - 2. Seamless Aluminum Pipe and Seamless Extruded Tubes: ASTM B 241.
- F. Aluminum Tubing:
 - 1. Seamless Drawn Aluminum Tubes: ASTM B 210.
 - 2. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.
- G. Aluminum Die and Hand Forgings: ASTM B 247.
- H. Aluminum Castings: ASTM B 26.

2.6 ACCESSORIES

- A. Flanges and Anchors: Unless otherwise indicated, provide cast or formed metal of the same type, material, and finish as the supported metal fabrications.
- B. Grout:
 - 1. Description: Pre-packaged, non-shrink, non-metallic, non-corrosive, non-staining, non-gaseous grout conforming to ASTM C 1107, Grade A (drypack) and Grades B and C (flowable grout) of a consistency suitable for application within a 30-minute working time.
 - 2. Type: Grout specifically recommended by the manufacturer for interior and exterior applications.
 - 3. Minimum 28-day Compressive Strength: At least 7,500 pounds per square inch.

C. Bituminous Paint:

1. Description: Cold-applied asphalt mastic conforming to SSPC publication PS 9.01, *"Cold-Applied Asphalt Mastic Painting System with Extra-Thick Film"* and containing no asbestos fibers; or cold-applied asphalt emulsion conforming to ASTM D 1187.
2. Application: Used for aluminum surfaces in contact with masonry, concrete, or steel.

D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.7 FABRICATION

A. Shop Fabrication:

1. Fabricate items in largest sections practicable to minimize field jointing.
2. Fabricate exposed work precise, straight, and true to line, size, and shape; plumb, level, and square within allowable tolerances; and with accurate angles and surfaces, and crisp straight edges.
3. Fabricate exposed connections with flush hairline joints, and square and true edges and corners.
4. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the strength of the material.
5. Bend pipe without collapsing or deforming its walls, to produce a smooth, uniform curved section and to maintain uniform sectional shape.
6. Form simple and compound curves by bending members in 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.
7. Cut, reinforce, drill, punch, thread, and tap metal fabrications as necessary to receive other fabrications, components, accessories, hardware, and similar items, and as required to securely attach to supporting construction
8. Before cleaning, treating, and applying specified finishes, remove blemishes by grinding.
9. Remove sharp or rough areas on exposed traffic surfaces. Ease exposed edges to a nominal 1/32-inch radius.

B. Fabrication Tolerances: Fabricated items must conform to the following; specified tolerances are non-cumulative.

1. Squareness: Not more than 1/8-inch difference in diagonal measurements.
2. Maximum Offset between Components at Joints: 1/16-inch except that at welded joints, offsets are prohibited.
3. Maximum Misalignment of Adjacent Members: 1/16-inch.
4. Maximum Bow: 1/8-inch in 48 inches.
5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.8 FINISHES

A. Natural (Uncoated) Steel Finish:

1. Remove visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants from all steel surfaces in conformance with SSPC publication SP1, *"Solvent Cleaning"*.
2. After fabrication, remove loose mill scale, rust, paint, and other deleterious material from all steel surfaces in conformance with SSPC publication SP2, *"Hand Tool Cleaning"*.

2.9 DISSIMILAR METAL CORROSION PROTECTION

A. Review dissimilar metals for potential galvanic action.

B. Ensure metal surfaces are permanently isolated from direct contact with potentially corrosive substrates by

1. applying the alkali-resistant coating specified above to each metal surface in direct contact with concrete, lime mortar, or other masonry materials, or similar cementitious materials;
2. applying either the bituminous coating specified above or a rubberized-asphalt coating to a total DFT of at least 40 mils to each metal surface in direct contact with incompatible metals, wood, or similar corrosive substrates; or to anodic metal surface when incompatible metals are in direct contact; or
3. providing high impact polystyrene shims to provide cathodic isolation between aluminum plates and steel, and metal plates and concrete

C. Ensure runoff is directed or diverted so as to prevent water from passing over or across dissimilar metals.

1. Arrange metals along water runoff paths in a series from anodic metals (e.g., aluminum) to cathodic metals (e.g., copper) to prevent runoff from cathodic metals (e.g., copper flashings) from flowing over anodic metals (e.g., aluminum gutters).
2. Where drainage from cathodic metals (e.g., copper roof panels) might pass over anodic metals (e.g., aluminum gutters), apply a protective coating acceptable to the Architect to the surfaces of the anodic metals.

Metal	Electronegativity
Lithium	Anodic (Active) End Less Noble (corrosion occurs this end)
Potassium	
Sodium	
Zinc	
Aluminum 5052, 3004, 3003, 1100, 6053	

Metal	Electronegativity
Cadmium	
Iron and Mild Steel	
Chrome Iron	
Stainless Steel (active)	
Tin-lead solder	
Lead	
Tin	
Nickel	
Brass	
Copper	
Bronze	
Stainless Steel (passive)	
Silver	
Titanium	
Platinum	
Gold	More Noble (no corrosion this end)
	Cathodic (Passive) End

- D. Ensure small anodic metals items (e.g., aluminum rivets) are not placed in contact with large cathodic metals (e.g., a large piece of steel sheet).
- E. Provide a non-absorbent insulate between dissimilar metal surfaces that contact one another (e.g., polypropylene tape at least 1.7 mils thick with a dielectric strength of 300-400 volts/mil). Before connecting, prime or paint each dissimilar metal contact surface, even if they have protective coatings.
- F. Ensure fasteners are made of the same material being fastened or have a suitable barrier protection coating.
 - 1. Apply corrosion-inhibiting material (e.g., pastes, washers, compounds, etc.) under the heads of screws or bolts inserted into dissimilar metal, even if they already have been treated or have a protective coating.
 - 2. Washers, gaskets, and sleeves must be made of plastic or closed-cell polychloroprene (Neoprene).
- G. Protect aluminum from the following.
 - 1. Dissimilar Materials: Where aluminum surfaces come into contact with dissimilar metals other than active stainless steel, zinc, or zinc coatings, isolate the aluminum

- from direct contact by painting the dissimilar metal with a prime coat of alkyd-type zinc primer followed by aluminum paint applied to a total DFT of at least 3.0 mils.
2. Cementitious Materials: Where aluminum surfaces come into contact with concrete, plaster, or mortar and other cementitious materials, isolate the aluminum surfaces from direct contact by applying bituminous paint to the aluminum surfaces to a total of at least 25 mils DFT.
 3. Wood and Other Absorptive Materials: Where aluminum surfaces come into contact with wood, treated wood, or similar absorptive materials that are subject to repeated wetting, isolate the aluminum surfaces from direct contact by
 - a. applying bituminous paint to the aluminum surfaces to a total of at least 25 mils DFT; or
 - b. applying aluminum paint to the wood, treated wood, or similar absorptive material surfaces to a total DFT of at least 3.0 mils, and then continuously sealing joints with weather sealing joint sealant specified in Section 07 92 00.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify that in-place construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the fabricator's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for metal fabrication installation.
 2. Set metal fabrications true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
 3. Shim as required with concealed shims.

4. Dry-pack metal fabrications supported on concrete and masonry to provide firm, level bearing surfaces.
5. Provide temporary bracing or anchors for items indicated as built into concrete, masonry, or similar construction.
6. Fit exposed connections accurately to form flush hairline joints

B. Interface with Adjacent Items:

1. Attachment: Provide materials, components, and accessories normally furnished or necessary to securely attach metal fabrications to supporting construction.
2. Field Welding:
 - a. Comply with AWS quality standard publications for manual shielded arc welding procedures, appearance and quality of welds, and methods to correct faulty welds.
 - b. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - c. Before welding, grind to remove zinc coating from one to 4 inches from either side of the intended weld zone and on both sides of the item.
 - d. Obtain fusion without undercut or overlap.
 - e. Promptly remove welding flux.
 - f. 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.
 - g. Do not weld, cut, or abrade exterior surfaces hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - h. Field-weld connections indicated as exposed joints but cannot be shop-welded because of shipping size limitations.
 - i. Welds remaining exposed must be ground smooth and flush to match and blend with parent metal surfaces.
 - j. Clean field welds, weld spatter, bolted connections, and abraded areas promptly after installation.

- C. Installation Tolerances: Install metal fabrications to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.
- D. Damaged Primer Touchup: Clean and prepare damaged primed surfaces in conformance with manufacturer's published instructions and SSPC surface preparation standard SSPC-SP11 *"Power Tool Cleaning to Bare Metal"*.
1. Sand smooth and re-clean.
 2. Spot-prime bare metal surfaces with specified primer applied to a total spot primer DFT of at least 5 mils.
 3. Overlap undamaged primer areas with spot primer at least 2 inches.
- E. Damaged Galvanizing Touchup: Repair damaged galvanized items or re-galvanize items that cannot be satisfactorily repaired to the Architect's acceptance.
1. Zinc-Based Solder Repair: Repair damaged galvanizing in conformance with ASTM A 780 Annex A1.
 2. Organic Zinc-Rich Cold Galvanizing Compound Repair:
 - a. Repair damaged galvanizing in conformance with ASTM A 780 Annex A2
 - b. Apply cold galvanizing repair compound to a DFT of 1.5 plus or minus 0.5 mils per coat, when measured in conformance with SSPC publication SSPC-PA 2, *"Determining Compliance to Required DFT"*. Provide 2 coats.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 05 51 34 – LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof access vertical metal ladders.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 ALTERNATES

A. Description: As an alternative to manufactured ladders, steel ladders designed and fabricated in conformance with Section 05 50 00 may be provided in lieu of manufactured metal ladders.

1. Material: Fabricate from steel bars conforming to ASTM A 36 (mild steel), merchant quality.
2. Rungs: Provide one of the following, or equal.
 - a. "Mebac Surfaced Ladder Rungs – Grade #3 Surface Option" manufactured by Harsco Industrial IKG.
 - b. "SlipNOT Round Ladder Rungs – Grade 2, Medium Surface Texture" manufactured by W.S. Molnar Co.
3. Finishes: Comply with the requirements for preparing surfaces and applying shop primer.

B. Requisite Properties:

1. Vertical Height and Angle of Inclination: As indicated on the Drawings.
2. Ladders over 19.7 feet must have intermediate or linking platforms.
3. Safety cages are required for ladders over 24 feet and ladders in high or hazardous areas. Landing platforms are required 50 feet above the ladder bottom. A rail-and-harness fall arrest system may be provided as alternate to safety cages and landing platforms.
4. Minimum Overhead Clearance: At least 84 inches.
5. Minimum Ladder Distance (Gap Accommodating Toe Space) from Surface (at 90 Degrees): At least 7 but not more than 8 inches.

6. Minimum Horizontal Clearance (from Ladder Face and Obstacles): At least 29-1/2 inches; or at least 23 inches in way of openings.
7. Maximum Distance between Ladder Attachments: Not more than 8 feet.
8. Distance between Ladder Rungs: At least 11 but not more than 12 inches.
9. Maximum Skew Angle: Not more than 2 degrees.
10. Minimum Stringer Separation (Width): At least 20 inches.
11. Side Rails: At least 2-1/2-inch deep aluminum channels.
12. Rung Design: Provide round or square bar rungs; where square bar is fitted, orientation must be edge up. Rungs must be evenly spaced throughout the full ladder run.

C. Performance Requirements:

1. Minimum Overall Capacity: At least 1,000 pounds total.
2. Minimum Rung Capacity: At least 500 pounds per rung.

1.3 REFERENCES

A. Definitions:

1. Manufacturer: Means the ladder manufacturer, unless otherwise indicated.
2. Vertical Ladder: Means a ladder having a fixed angle of inclination of between 76 and 90 degrees from the horizontal.
3. Inclined Ladder: Means a ladder having a fixed angle of inclination of between 60 and 75 degrees from the horizontal.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

B. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Ladders must be obtained through one source from the same manufacturer (to ensure compatibility and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Safety Requirements: Ladders must be certified as meeting or exceeding the requirements of OSHA Regulations 29 CFR 1910.25-1910.27. *"Fixed Ladders"*; and American National Standard Institute publication ANSI A14.3, *"Ladders – Fixed – Safety Requirements"*.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.

1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)

3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage.
- C. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 VERTICAL METAL LADDERS

- A. Description: Manufactured aluminum fixed ladder assembly.
- B. Products: Provide one of the following, or equal.
 1. "Model 560" manufactured by Alaco Ladder Co.
 2. "Model 500" manufactured by O'Keeffe's, Inc.
 3. "Model FL-02" manufactured by Precision Ladders.

2.3 ACCESSORIES

- A. Mounting Brackets: Manufacturer's standard brackets in sizes required for specified ladders; manufacturer's standard finish.
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install ladders using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 - 4. Installed ladders must be warrantable. Do not install, correct, or replace ladders in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach ladders to supporting construction.
- C. Installation Tolerances: Install ladders to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stair railings and guardrails.
- B. Free-standing railings at steps and ramps.

1.2 RELATED REQUIREMENTS

- A. Section 099713 - High-Performance Steel Coatings
- B. Section 321313 - Concrete Paving
- C. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet

1.3 REFERENCE STANDARDS

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2000 (Reapproved 2006).
- E. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Fabricator's Qualification Statement.
- D. Sustainable Design Submittals

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications:

1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.

1.6 QUALITY ASSURANCE

A. Railings and handrails: CBC Section 11B-505:

1. Top of gripping surfaces of handrails shall be 34 inches minimum and 38 inches maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2 inches minimum. Handrail may be located in a recess if the recess is 3 inches maximum deep and 18 inches minimum clear above the top of the handrail.
3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20 percent of their length. Where provided, horizontal projections shall occur 1-1/2 inches minimum below the bottom of the handrail gripping surfaces.
4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4 inches minimum and 2 inches maximum.
5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4 inches minimum and 6-1/4 inches maximum, and a cross-sectional dimension of 2-1/4 inches maximum.
6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
7. Handrails shall not rotate within their fittings.
8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.

9. A 2 inch minimum high curb or a barrier shall be provided to prevent the passage of a 4 inch diameter sphere rolling off the sides of a ramp surface. Such a curb or barrier shall be continuous and uninterrupted along the entire length of a ramp. CBC Section 11B-405.9.2.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 1. Pre-consumer and Post-consumer Recycled Content
 2. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 3. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.
- B. Allow for expansion and contraction of members and building movement without damage to connections or members.
- C. Dimensions: See drawings for configurations and heights.
- D. Provide anchors and other components 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.
- E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.
- F. Top of gripping surfaces of handrails shall be 34" minimum and 38" maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
- G. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2" minimum. Handrail may be located in a recess if the recess is 3" maximum deep and 18" minimum clear above the top of the handrail.

- H. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20% of their length. Where provided, horizontal projections shall occur 1-1/2" minimum below the bottom of the handrail gripping surfaces.
- I. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4" minimum and 2" maximum.
- J. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4" minimum and 6-1/4" maximum, and a cross-sectional dimension of 2-1/4" maximum.
- K. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
- L. Handrails shall not rotate within their fittings.
- M. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with **CBC Section 11B-505.10**. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
- N. A 2" minimum high curb or a barrier shall be provided to prevent the passage of a 4" diameter sphere rolling off the sides of a ramp surface. Such a curb or a barrier shall be continuous and uninterrupted along the length of a ramp. **CBC Section 11B-405.9.2**.

2.3 STEEL RAILING SYSTEM

- A. Steel Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
- B. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.4 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.

- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Anchor railings securely to structure.

3.2 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION 055213

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SECTION 05 70 00 – DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated decorative metal items.
2. Delegated design of decorative metal items.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 05 05 14 for shop-applied primer.
3. Section 05 05 23 for non-structural metal fastenings.
4. Section 05 50 00 for shop-fabricated non-decorative metal items; and for dissimilar metal corrosion protection.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AWS: American Welding Society.

B. Definitions:

1. Fabricator: Means the decorative metal fabricator, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design Requirements:

1. Engineer, fabricate, assemble, and install decorative metals that conforms to the profiles indicated and other Contract Document requirements; meets specified performance criteria; and results in structurally sound, non-corroding, and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.

B. Performance Requirements:

1. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
2. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: For manufactured items, submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing decorative metal layout and types. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions. Cross-reference details to plans and elevations.
 - c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
 - d. Show backings, embedments, fasteners, brackets, clips, cleats, straps, mounting devices, and other attachments.
 - e. Label each attachment type; indicate manufacturer's product name for each manufactured item.
 - f. Indicate base material and finish, fastener material and finish, and material and finish of items being fastened or attached.
 - g. Label welds in conformance with the requirements of AWS publication A2.4, *"Standard Symbols for Welding, Brazing, and Nondestructive Examination"*.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; analysis of supporting construction, including section-property computations; analysis of fasteners,

anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.

- c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

1. Welding Standards: Welding procedures must conform to the requirements of the following American Welding Society publications.
 - a. AWS D1.1, "*Structural Welding Code – Steel*".
 - b. AWS D1.2, "*Structural Welding Code – Aluminum*".
 - c. AWS D1.6, "*Structural Welding Code – Stainless Steel*".
 - d. AWS D9.1, "*Sheet Metal Welding*".
 - e. AWS D18.2, "*Stainless Steel Tube Discoloration Guide*".

B. Qualifications:

1. Fabricator: Company or individuals must have at least 10 years' experience fabricating decorative metals installed on at least 100 previous projects similar to this project in size, material, design, and complexity
2. Installer: Company or individuals must have at least 5 years' experience installing decorative metals for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Welders: Welding personnel and supervisors must comply with the "*Qualification*" requirements of AWS quality standard publications. Only certified welders current in their certification may perform or supervise any welding work.
4. Supervisors: Individuals must have at least 7 years' experience installing decorative metals for at least 30 previous projects similar to this project in size, material,

design, and complexity, including at least 2 years' supervisory experience directing and leading decorative metal installers.

5. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective decorative metals with undamaged new decorative metals that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 STEEL

- A. Steel Plate: ASTM A 36 (mild steel).
- B. Uncoated Steel Coil, Sheet, and Strip: Finished cold-rolled steel coil, sheet, and strip conforming to ASTM A 1008, CS Type B (commercial steel), unexposed (interior items) and exposed, temper rolled (exterior items), regular matte finish (40 to 59 AA), mill phosphatized.
- C. Hot-Rolled Steel Rods, Bars, and Shapes: ASTM A 36 (mild steel), merchant quality.
- D. Steel Pipe: ASTM A 53, black pipe, Type and Grade indicated below; size and weight class, schedule number, or outside diameter indicated, and wall thickness required by engineering calculations for type of use indicated.
 - 1. Appearance: Type S (seamless).
 - 2. Bending: Provide Grade A pipe when cold bending is required; otherwise provide Grade B pipe.
- E. Steel Tubing:
 - 1. Steel Structural Tubing: ASTM A 500, Grade A, black, round or shaped hot-formed tubing as indicated, outside diameter or dimensions as indicated, and calculated wall thickness as required by engineering calculations for type of use indicated. Provide seamless tubing.
 - 2. Mechanical Tubing: ASTM A 513, black, Type 5 M.D. (mandrel drawn or Drawn over a Mandrel).

2.3 STAINLESS STEEL

- A. Stainless Steel Bars, Hot-Rolled or Extruded Shapes: ASTM A 276, Condition T (hardened and tempered at a relatively high temperature), Type 304L (for welded applications) or Type 304 (for all other applications) No. 4 (directional) finish, passivated in conformance with ASTM A 967.
- B. Stainless Steel Pipe: ASTM A 312, Grade TP (pipe), Type 304L (for welded applications) or Type 304 (for all other applications) No. 4 (directional) finish, passivated in conformance with ASTM A 967.
- C. Stainless Steel Plate and Flat Bar:
 - 1. Exposed Locations: ASTM A 666 (annealed and tempered), Type 304L (for welded applications) or Type 304 (for all other applications) No. 2 (half hard) temper (hardness between Rockwell B-65 and B-70; can be bent 90 degrees across the direction of rolling around a radius equal to its thickness), passivated in conformance with ASTM A 967.
 - 2. Concealed Locations: ASTM A 240 (annealed) Type 304L (for welded applications) or Type 304 (for all other applications), No. 2 (half hard) temper (hardness between Rockwell B-65 and B-70; can be bent 90 degrees across the direction of rolling around a radius equal to its thickness), passivated in conformance with ASTM A 967.

- D. Stainless Steel Tubing: ASTM A 554, Grade MT (tubing), Type 304L (for welded applications) or Type 304 (for all other applications), No. 4 (directional) finish, passivated in conformance with ASTM A 967.

2.4 ALUMINUM

- A. Standard Structural Profiles (Alloy 6061-T6): ASTM B 308.
- B. Extruded Bars, Shapes and Tubes:
 - 1. Standard Structural Profiles (Alloy 6061-T6): ASTM B 308.
 - 2. Extruded Aluminum Bars and Shapes: ASTM B 221.
 - a. Alloy and Temper: 6063-T5 or T6 for primary components; 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
 - b. Minimum Thickness: At least 0.125-inch.
- C. Sheet and Plate: ASTM B 209.
 - 1. Alloy and Temper: 5005-H32 (for anodic finishing), or alloy 3003-H14 (for painted or unfinished sheet).
 - 2. Minimum Thickness: At least 0.060-inch.
- D. Aluminum Tubing:
 - 1. Seamless Drawn Aluminum Tubes: ASTM B 210.
 - 2. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.

2.5 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 FABRICATION

- A. Shop Fabrication:
 - 1. Fabricate items in largest sections practicable to minimize field jointing.
 - 2. Fabricate exposed work precise, straight, and true to line, size, and shape; plumb, level, and square within allowable tolerances; and with accurate angles and surfaces, and crisp straight edges.
 - 3. Fabricate exposed connections with flush hairline joints, and square and true edges and corners.
 - 4. Form bent metal corners to the smallest radius possible without causing grain separation or otherwise impairing the strength of the material.

5. Bend pipe without collapsing or deforming its walls, to produce a smooth, uniform curved section and to maintain uniform sectional shape.
 6. Form simple and compound curves by bending members in 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.
 7. Cut, reinforce, drill, punch, thread, and tap decorative metal as necessary to receive other fabrications, components, accessories, hardware, and similar items, and as required to securely attach to supporting construction
 8. Before cleaning, treating, and applying specified finishes, remove blemishes by grinding.
 9. Remove sharp or rough areas on exposed traffic surfaces. Ease exposed edges to a nominal 1/32-inch radius.
- B. Fabrication Tolerances: Fabricated items must conform to the following; specified tolerances are non-cumulative.
1. Squareness: Not more than 1/8-inch difference in diagonal measurements.
 2. Maximum Offset between Components at Joints: 1/16-inch except that at welded joints, offset are prohibited.
 3. Maximum Misalignment of Adjacent Members: 1/16-inch.
 4. Maximum Bow: 1/8-inch in 48 inches.
 5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.7 FINISHES

- A. Shop Priming: Specified in Section 05 05 14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify that in-place construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the fabricator's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for decorative metal installation.
2. Set decorative metals true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
3. Shim as required with concealed shims.
4. Dry-pack decorative metals supported on concrete and masonry to provide firm, level bearing surfaces.
5. Provide temporary bracing or anchors for items indicated as built into concrete, masonry, or similar construction.
6. Fit exposed connections accurately to form flush hairline joints

B. Interface with Adjacent Items:

1. Attachment: Provide materials, components, and accessories normally furnished or necessary to securely attach decorative metals to supporting construction.
2. Field Welding:
 - a. Comply with AWS quality standard publications for manual shielded arc welding procedures, appearance and quality of welds, and methods to correct faulty welds.
 - b. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - c. Before welding, grind to remove zinc coating from one to 4 inches from either side of the intended weld zone and on both sides of the item.
 - d. Obtain fusion without undercut or overlap.
 - e. Promptly remove welding flux.
 - f. 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.
 - g. Do not weld, cut, or abrade exterior surfaces hot-dip galvanized after fabrication and are for bolted or screwed field connections.
 - h. Field-weld connections indicated as exposed joints but cannot be shop-welded because of shipping size limitations.
 - i. Welds remaining exposed must be ground smooth and flush to match and blend with parent metal surfaces.
 - j. Clean field welds, weld spatter, bolted connections, and abraded areas promptly after installation.

- C. Installation Tolerances: Install decorative metals to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.
- D. Damaged Primer Touchup: Clean and prepare damaged primed surfaces in conformance with manufacturer's published instructions and SSPC surface preparation standard SSPC-SP11 "*Power Tool Cleaning to Bare Metal*".
 1. Sand smooth and re-clean.
 2. Spot-prime bare metal surfaces with specified primer applied to a total spot primer DFT of at least 5 mils.
 3. Overlap undamaged primer areas with spot primer at least 2 inches.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed decorative metal in place from deterioration and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed decorative metals unless they are protected from damage. Do not use installed decorative metal as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

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DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

SECTION 061000 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural dimension lumber framing.
- B. Non-structural dimension lumber framing.
- C. Rough opening framing for doors, windows, and roof openings.
- D. Sheathing.
- E. Roof-mounted curbs.
- F. Roofing nailers.
- G. Roofing cant strips.
- H. Preservative treated wood materials.
- I. Concealed wood blocking, nailers, and supports.
- J. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 033000 - Cast-in-Place Concrete: Setting anchors in concrete.
- C. Section 061800 - Glued-Laminated Construction.
- D. Section 072500 - Weather Barriers: Air barrier over sheathing.
- E. Section 072500 - Weather Barriers: Water-resistive barrier over sheathing.
- F. Section 076200 - Sheet Metal Flashing and Trim: Sill flashings.
- G. Section 077200 - Roof Accessories: Prefabricated roof curbs.
- H. Section 092116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- C. PS 1 - Structural Plywood; 2009.
- D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; 2010.
- E. PS 20 - American Softwood Lumber Standard; 2010.
- F. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2004, and supplements.
- G. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.
- D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- E. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. Species: Douglas Fir-Larch, unless otherwise indicated.
 - 2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 STRUCTURAL COMPOSITE LUMBER

- A. Structural Composite Lumber: Factory fabricated beams, headers, and columns, of sizes and types indicated on drawings; structural capacity as published by manufacturer.
 - 1. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): 2,000,000 psi, minimum.

2.3 CONSTRUCTION PANELS

- A. Roof Sheathing: Any PS 2 type, rated Structural I Sheathing.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: Equal to plywood thickness specified on structural drawings PERF CAT.
- B. Wall Sheathing: Any PS 2 type.
 - 1. Bond Classification: Exterior.
 - 2. Grade: Structural I Sheathing.
 - 3. Span Rating: 24.
 - 4. Performance Category: Equal to plywood thickness specified on structural drawings PERF CAT.
 - 5. Edge Profile: Square edge.

- C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.5 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.3 FRAMING INSTALLATION

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices unless otherwise specifically detailed.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes.
- E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.4 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.5 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.6 INSTALLATION OF CONSTRUCTION PANELS

- A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
 - 1. At long edges provide solid edge blocking where joints occur between roof framing members.

2. Nail panels to framing; staples are not permitted.
- B. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 3. Install adjacent boards without gaps.
 4. Size and Location: As indicated on drawings.

3.7 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.8 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

3.9 CLEANING

- A. Waste Disposal: Comply with the requirements of Section 017419 - Construction Waste Management and Disposal.
 1. Comply with applicable regulations.
 2. Do not burn scrap on project site.
 3. Do not burn scraps that have been pressure treated.
 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 061000

SECTION 06 10 53 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Utilitarian lumber and plywood not specified in other sections.
2. Telephone and electrical equipment backing panels.
3. Preservative treated wood.
4. Fire-retardant treated wood.
5. Rough hardware.
6. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. ACQ: Alkaline Copper Quaternary.
2. APA: Means the Engineered Wood Association.
3. ASME: American Society of Mechanical Engineers.
4. AWWPA: American Wood Protection Association.
5. CCA: Chromium Copper Arsenate.
6. FRTW: Fire Retardant Treated Wood.
7. PTW: Preservative Treated.
8. S4S: Surfaced Four Sides.
9. WCLIB: West Coast Lumber Inspection Bureau.

B. Definitions:

1. Manufacturer: Means the plywood, PTW, FRTW, rough hardware, or accessory manufacturer, as the context admits, unless otherwise indicated.
2. Pressure-Treated Wood: Means either PTW or FRTW.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Provide fasteners and accessories suitable for the type of use and conditions of installation and service; and as required to produce secure attachment to supporting construction without staining or deterioration of either base materials or fastened materials; nor deterioration of the fastener itself when in contact with base materials and fastened materials.
 - 1. Fastening Pressure-Treated Wood: Fasteners must resist corrosion when in contact with materials used in the pressure treating process that are either present at the time of installation or occur in the presence of moisture.
 - a. Provide ceramic-coated anti-corrosive steel fasteners and hot-dip galvanized steel connectors conforming to ASTM A 653 Class G185 or provide Type 316 stainless steel fasteners and connectors.
 - b. Fasteners and connectors made from uncoated (bare) carbon steel, electrodeposited zinc-coated steel, and aluminum are prohibited.
 - 2. Other Exterior Locations: Provide ceramic-coated anti-corrosive steel fasteners or stainless steel fasteners.
 - 3. Elsewhere: Fasteners may be coated or uncoated, as selected by the Contractor, unless otherwise indicated or specified.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: For manufactured items, submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing rough carpentry attachment to supporting construction; and other conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples: When requested by the Architect, submit full-size samples of selected metal fasteners.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished rough carpentry.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature.
 5. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to heat or sudden changes in temperature; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in a manner that that prevents damage.

- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective materials with undamaged new materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.
 - 3. Formaldehyde emissions criteria:
 - a. Composite wood products to meet one of the following criteria per TPA TSCA Title VI or CARB ATCM.
 - 1) Ultra-low emitting formaldehyde (ULEF).
 - 2) No added formaldehyde resins (NAF).

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide lumber and plywood manufactured by one of the following, or equal.
 - 1. Boise Cascade LLC.
 - 2. Georgia-Pacific Wood Products LLC.
 - 3. Louisiana-Pacific Corp.
 - 4. Weyerhaeuser NR Co.

2.3 SAWN LUMBER

- A. Timber for Wood Beams, Stair Stringers, and Posts: "SELECT STRUCTURAL" grade Douglas fir conforming to WCLIB Grading Rules, S4S, seasoned to a moisture content of not more than 19 percent, and stamped showing only the appropriate fiber stress in bending "F".
- B. Rough Sawn Lumber: "#1" or "#2" grade Douglas conforming to WCLIB Grading Rules, rough sawn, dried to a moisture content of not more than 19 percent, and stamped "S-DRY" or "KD".
- C. Full-Dimension Lumber: "#1" or "#2" grade Douglas conforming to WCLIB Grading Rules, S4S, seasoned to a moisture content of not more than 19 percent, and stamped "S-DRY" or "KD".

2.4 SOFTWOOD PLYWOOD

- A. Softwood Plywood:
 - 1. Minimum Sheathing Grade: "APA C-C Plugged & Touch Sanded EXT" grade plywood, unless otherwise indicated. Plywood panels must have a visible APA grade mark.
 - 2. Minimum Underlayment Grade: "APA Tongue & Groove" grade plywood, unless otherwise indicated. Plywood panels must have a visible APA grade mark.
 - 3. Minimum Size: At least 4- by 8-foot nominal sheet size.
 - 4. Minimum Thickness: At least 1/2-inch nominal thickness, unless otherwise indicated.
 - 5. Construction:
 - a. 3/4-inch plywood: 7-ply veneer core.
 - b. 1/2-inch plywood: 5-ply veneer core.
 - 6. Panel Edges: Square-edged.
- B. Telephone and Electrical Equipment Backing Panels:

1. Minimum Grades: "APA Type A-D" grade sanded plywood. Plywood panels must have a visible APA grade mark.
2. Minimum Thickness: At least 3/4-inch nominal thickness, unless otherwise indicated.
3. Construction: 7-ply veneer core.
4. Panel Edges: Square-edged.
5. Finish: Field-applied intumescent white paint finish. Paint both sides of plywood to prevent warping.

2.5 PRESERVATIVE TREATED WOOD (PTW)

- A. Description: Wood products conforming to the AWPA U1 manufactured with ACQ wood preservative. PTW containing arsenic or CCA are prohibited.
 1. Interior wood construction not in contact with the ground must conform to Use Category UC2.
 2. Exterior wood construction not in contact with the ground must conform to Use Category UC3b.
 3. Wood contacting the ground must conform to Use Category UC4a.
- B. Application: Provide PTW at the following locations and where indicated.
 1. Concealed rough carpentry items in contact with concrete or masonry.
 2. Miscellaneous wood framing attached directly to the interior of below-grade exterior masonry or concrete walls.
 3. Rough carpentry in contact with roofing, metal flashings, vapor retarders or barriers, air barriers, or waterproofing.
 4. Wood framing members less than 18 inches above the ground in crawl spaces or unexcavated areas.
 5. Wood floor plates installed on concrete slabs-on-grade.
 6. Wood items exposed to weather.
- C. Products: Provide the following manufactured by Sunbelt Forest Products Corp., or equal.
 1. Termite Resistant Wood: "Timbersave PT", or equal.
 2. Decay and Termite Resistant Wood: "Preserve", or equal.
 3. Decay, Termite, and Water Resistant Wood: "Preserve Plus", or equal.
- D. Requisite Properties:
 1. Minimum Retention: At least 0.25 pounds per cubic foot in conformance with AWPA C2 for lumber and timber and AWPA C9 for plywood.
 2. Maximum Moisture Content: Kiln dry after treatment to a moisture content of not more than 19 percent for lumber, and not more than 15 percent for plywood.

2.6 FIRE-RETARDANT TREATED WOOD (FRTW)

- A. Description: Wood products conforming to AWPA C20 and AWPA C27, manufactured with fire-retardant materials for which the fire-retardant manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested in conformance with ASTM D 5664 and ASTM D 5516.
 - 1. Provide exterior type wood at exterior locations.
 - 2. Provide Type A High Temperature (HT) wood at interior locations.
- B. Application: Provide FRTW at the following locations and elsewhere where indicated.
 - 1. Framing for raised platforms.
 - 2. Concealed blocking.
 - 3. Roof construction.
 - 4. Plywood backing panels.
 - 5. Other wood items installed within fire-resistive construction.
 - 6. Elsewhere where indicated.
- C. Restrictions: Fire-retardant products must not develop or advance metal fastener corrosion.
- D. Products: Provide the following manufactured by Hoover Treated Wood Products, Inc., or equal
 - 1. Interior Locations: "Pyro-Guard", or equal.
 - 2. Exterior Locations: "Exterior Fire-X", or equal.

2.7 ROUGH HARDWARE

- A. Uncoated (Bare) Carbon Steel Fasteners:
 - 1. Screws: Manufactured from carbon steel wire rods and uncoated coarse round wire conforming to ASTM A 510, Grades 1018 to 1022.
 - 2. Bolts: ASTM A 307, Grade A.
 - 3. Nuts and Flat Washers: ASTM A 563, Grade C3.
- B. HDG Zinc-Coated Steel Fasteners:
 - 1. Description: Carbon steel fasteners with hot dip galvanized coating conforming to
 - a. ASTM A 153 minimum zinc coating weight requirements for Class C materials (fasteners over 3/8-inch diameter and similar articles; washers 3/16-inch and 1/4-inch thick) or Class D materials (fasteners 3/8-inch diameter and under, rivets, nails and similar articles; washers under 3/16-inch thick); and
 - b. ASTM F 2329 for coating of threaded fasteners and washers by hot-dip zinc galvanizing.
 - 2. Performance Requirements: No sign of surface red rust after at least 32 hours of ASTM B117 salt spray test performed on screws after being driven through and removed from sheet metal panels.

C. Stainless Steel Fasteners:

1. Description: Austenitic stainless-steel screws, bolts, and studs conforming to ASTM F 593 and nuts conforming to ASTM F 594 requirements for Alloy Group 1 (304 Series) or Alloy Group 2 (316 Series).
2. Performance Requirements:
 - a. Type 304: No sign of surface red rust after at least 1,000 hours of ASTM B117 salt spray test performed on screws after being driven through and removed from sheet metal panels.
 - b. Type 316: No sign of surface red rust after at least 1,500 hours of ASTM B117 salt spray test performed on screws after being driven through and removed from sheet metal panels.

D. Ceramic-Coated Anti-Corrosive Steel Fastener Material:

1. Description: Carbon steel fasteners having 3-coat finish that provides electrolytic corrosion protection by combining the sacrificial protection of zinc with the barrier protection of a ceramic topcoat and having a current evaluation report from the ICC-ES demonstrating code compliance.
2. Application: Use ceramic-coated anti-corrosive steel fasteners
 - a. with pressure treated wood, including alkaline copper quaternary (ACQ), ammoniacal copper arsenate (ACA), chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), copper azole (CBA-A and CA-B), copper citrate (CC), and disodium octaborate tetrahydrate (DOT);
 - b. when attaching to exotic hardwood lumber base material;
 - c. with composite lumber; and
 - d. when attaching cement board, high-density exterior sheathing, and tile backer board to framing members at exterior walls, at high-moisture interior walls, and in high-corrosion environments.
3. Product: "Grabber" screws manufactured by Grabber Construction Products, or equal.
4. Requisite Properties:
 - a. Basecoat An 8- to 10-micron (0.0003- to 0.0004-inch) mechanically deposited zinc-alloy coating.
 - b. Intermediate Coat: Chromate conversion coating.
 - c. Topcoat: Corrosion-resistant baked ceramic surface coating.
5. Performance Requirements: No sign of surface red rust after at least 1,000 hours of ASTM B 117 salt spray test performed on screws after being driven through and removed from sheet metal panels.

E. Nails, Brads, and Staples: Provide fasteners conforming to ASTM F 1667.

1. Fastening Lumber to Lumber: Cement-coated or annular (ringed-shank) threaded nails of sufficient length to penetrate at least 1-1/4-inches into adjoining items; or stove or lag bolts used with washers.
2. Fastening Plywood to Lumber: Annular (ringed-shank) threaded nails; at least size 8d for 1/2-inch panels and at least size 10d for 3/4-inch panels.

- F. Power-Driven Staples, Nails, P-nails, and Allied Fasteners: Must conform to ICC-ES Evaluation Report No. 1539.
- G. Wood Screws: Must conform to ASME B18.6.1.
- H. Steel Drill Screws for Fastening Wood to Cold-Formed Metal Framing: Must conform to ASTM C 954, except with wafer heads and reamer wings, length as recommended by the screw manufacturer for material being fastened.
- I. Bolts:
 - 1. Steel Bolts: ASTM A 307 Grade A with hex nuts conforming to ASTM A 563, and flat washers where indicated.
 - 2. Anchor Bolts: ASTM F 1554 Grade 36. Provide hot-dip zinc-coated anchor bolts where item being fastened is galvanized.
 - 3. Lag Bolts: Must conform to ASME B18.2.1.

2.8 ACCESSORIES

- A. Wood Glue:
 - 1. Description: Yellow aliphatic resin polyvinyl acetate (PVA) glue.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Elmer's Products Inc.
 - b. Franklin International.
 - c. Gorilla Glue, Inc.
 - 3. Products: Provide the following manufactured by Franklin International, or equal.
 - a. Interior Grade Glue: "Titebond Original", or equal.
 - b. Exterior Grade Glue: "Titebond III Ultimate", or equal.
 - c. Moulding and Trim Glue: "Titebond Quick & Thick Mutisurface Glue", or equal.
- B. Construction Adhesive:
 - 1. Description: General purpose, indoor or outdoor, drillable, moisture resistant, sandable, heavy duty construction adhesive.
 - 2. Product: "Titebond PROvantage" manufactured by Franklin International, or equal.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify that in-place construction satisfies all other conditions that might affect the quality of installation or the durability, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify deficient and non-conforming project conditions.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for rough carpentry installation.
 - 2. Set rough carpentry true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
 - 3. Shim as required with concealed shims.
 - 4. Fit exposed connections accurately to form flush hairline joints
- B. Special Techniques:
 - 1. Sort and select lumber so natural characteristics do not interfere with installation or with fastening. Do not use materials with defects that interfere with function or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
 - 2. Provide blocking and framing normally furnished, indicated, or required to support facing materials, fixtures, specialty items, and trim.
 - 3. Provide metal clips for fastening gypsum board or lath at corners and intersections where blocking or framing does not provide a surface for fastening edges of panels. Do not space clips more than 16 inches on center.
 - 4. Install wood furring, sleeper, blocking, grounds, nailers, and other items where indicated or required for attaching other work.
 - 5. Make tight connections between members.
 - 6. Select fasteners of size that will not fully penetrate members where opposite side is exposed to view or will receive finish materials.

7. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Do not countersink nail heads, unless otherwise indicated.
 8. Install fasteners without splitting wood.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach rough carpentry to supporting construction.
- D. Installation Tolerances: Install rough carpentry within the following tolerance variations.
1. Maximum Out of Plumb: Not more than 1/4-inch in 10 feet.
 2. Maximum Out of Plane: Not more than 1/8-inch.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 06 16 43 – GMF GYPSUM SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. GMF gypsum sheathing.
2. Installation materials.
3. Joint treatment materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 07 54 19 for GMF roof cover boards.
3. Section 09 28 15 for GMF gypsum tile backing boards.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. GMF: Glass Mat Faced.

B. Definitions:

1. Manufacturer: Means the sheathing manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling: Schedule installation to keep sheathing exposure to UV within the manufacturer's recommended limits.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished sheathing.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
1. Sheathing must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Sheathing must be manufactured in North America by a domestic company from gypsum mined in North America; synthetic gypsum recovered from coal-fired plants operating in North America (FGD gypsum); or a combination of both.

- a. Sheathing manufactured outside of North America by a domestic company are prohibited.
- b. Sheathing manufactured outside of North America by a foreign company and relabeled or rebranded by a domestic company are prohibited.
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing sheathing for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing sheathing for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading sheathing installers.

1.6 HANDLING

- A. General: Comply with GA publication GA 801 "*Handling Gypsum Board*" and applicable requirements of ASTM C 1264 for the inspection, rejection, certification, packaging, marking, shipping, handling, and storage of gypsum sheathing products.
- B. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- C. Storage: Store unloaded items as shipped. Furnish adequate dunnage and bracing during storage.
 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to heat, sudden changes in temperature, and UV exposure beyond the manufacturer's limits; or exposed to other sources of deterioration and damage.
 3. If items are not stored in an enclosed location, then cover the tops and sides of stored items with securely-tied, waterproof, breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited (due to potential accumulation of moisture beneath the tarpaulin during certain environmental conditions).
 4. Incline covered items to ensure maximum drainage of accumulated moisture.
- D. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.

- E. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- F. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
 - 1. CertainTeed Corp.
 - 2. Georgia Pacific Gypsum LLC.
 - 3. National Gypsum Co.
 - 4. USG Corp.

2.3 GMF GYPSUM SHEATHING

- A. Description: Gypsum-based GMF commercial sheathing conforming to ASTM C 1177
- B. Application: Installed to the outside face of above-grade exterior wall framing members to serve as a substrate for exterior wall finishes.
- C. Restrictions: May not be used
 - 1. below grade;
 - 2. within roofing assemblies, including gypsum panels installed vertically within roofing assemblies on the roof side of parapet wall framing members as a substrate for the roofing membrane;
 - 3. as a backerboard for tile;
 - 4. as a structural product (may not be used in lieu of plywood where required);
 - 5. as a base for nailing or mechanical fastening; and
 - 6. for immersion in water or sustained exposure to water and moisture, including cascading roof or floor water, which must be directed away from the sheathing until appropriate drainage is installed.

D. Products: Provide one of the following, or equal.

1. "GlasRoc Sheathing" manufactured by CertainTeed Corp.
(ICC-ES Report No. ESR-2460)
2. "DensGlass Sheathing" manufactured by Georgia Pacific Gypsum LLC.
(ICC-ES Report No. ESR-3087)
3. "Gold Bond e2XP Extended Exposure Sheathing" manufactured by National Gypsum Co. (ICC-ES Report No. ESR-2743)
4. "SECUROCK Glass-Mat Sheathing Panels" manufactured by USG Corp.
(ICC-ES Report No. ESR-3044)

E. Requisite Properties:

1. Minimum Size: Provide at least 4-foot by 8-foot sheets.
2. Minimum Thickness: 1/2-inch regular core panels and 5/8-inch Type X panels.
3. Edges: Tapered long edges and square ends.
4. Facers: Heat-cured, acrylic-coated, fiberglass mat wrapped around panel face, back side, and long edges. Water repellent paper facers and backings are prohibited.
5. UV Exposure Limit: Cover within 270 calendar days.

2.4 INSTALLATION MATERIALS

- A. Fasteners: Provide 0.164-inch shank diameter (#8-32 UNC) by at least 1-1/4-inch-long Philips drive socket, bugle or wafer head, self-drilling stainless steel, bi-metal, duplex anti-corrosive steel, 3-coat anti-corrosive steel, or ceramic-coated anti-corrosive steel screw fasteners, unless another fastener type is explicitly indicated; or is otherwise supplied, required, recommended, or accepted by the manufacturer.

2.5 JOINT TREATMENT MATERIALS

- A. Sheathing Tape: Polypropylene panel joint tape is prohibited. (provides for short-term joint protection only)
- B. Joint Sealant:
1. Glass Mesh Tape Reinforcing:
 - a. Description: At least 2-inch wide, alkali-resistant, polymer-coated, 10x10 glass-fiber mesh tape. Polypropylene sheathing tape is prohibited.
 - b. Application: Used in combination with joint sealant as a panel joint and penetration treatment for long-term joint protection.
 - c. Product: Supplied, required, recommended, or accepted by the manufacturer.
 2. Sealant: Provide fluid-applied low modulus joint sealant specified in Section 07 92 00, unless another type of sealant; or supplied, required, recommended, or accepted by the manufacturer to seal sheathing joints and fastener penetrations.
- C. Seam Seal Tape (Alternate):

1. Description: 40-mil thick, self-adhering, cold-applied, rubberized asphalt/HDPE flexible flashing tape.
 - a. Acrylic-coated polypropylene sheathing tape is prohibited.
 - b. Glass mesh tape applied without sealant is prohibited.
2. Application: Used as an alternate panel joint and penetration treatment for long-term joint protection.
3. Products: Provide the following manufactured by GCP Applied Technologies, or equal, unless another type of seam seal tape is explicitly indicated; or is otherwise supplied, required, recommended, or accepted by the manufacturer.
 - a. Primer: "Perm-A-Barrier Primer Plus", or equal, water-based primer required for cementitious and exterior gypsum sheathing substrates.
 - b. Flashing Tape: "Perm-A-Barrier Wall Flashing", or equal, self-adhesive, rubberized asphalt/polyethylene flashing tape.
 - c. Maximum UV Exposure Limit: Cover within 60 days.

2.6 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:

1. Install sheathing using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed sheathing must be warrantable. Do not install, correct, or replace sheathing in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Furnish units in longest available lengths to minimize end joints.
 2. Pre-cut panels and make accurate cutouts for penetrations.
 3. Position gypsum sheathing next to framing with coated side away from studs.
 - a. Fit ends closely.
 - b. Cut panel to required size and make cutouts.
 - c. Leave 1/8-inch gap between penetrating items and panel edges.
 4. Orient panels with long edge perpendicular to framing and short edges vertically oriented and centered over studs.
 - a. Fit sheathing snugly around openings.
 - b. Install panels with at least a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - c. Install panels with at least a 1/4-inch gap where they abut masonry or similar materials that may retain moisture.
 - d. Do not bridge building expansion or seismic joints. Cut and space edges of panels to match framing spacing.
 5. Accurately fit exposed connections to form flush hairline joints.
 6. Securely fasten sheathing panels to framing.
 - a. Stagger vertical joints at least 16 inches on center, but not less than one framing space between adjacent rows.
 - b. Locate fasteners at least 3/8-inch from perimeter edges, and space fasteners a maximum of 8 inches on center, both along the panel perimeter and over the panel face.
 - c. Drive fasteners to bear tightly against sheathing faces. Do not break or rupture facing, fracture underlying core or countersink fasteners.
 - d. Do not use staples or adhesives to fasten sheathing to framing.
 7. When sheathing panels are installed in sloped wall applications, the sloped portions of the wall must be temporarily protected with a weather-resistive barrier specified in Section 07 25 13 until cladding systems are installed.
 8. Exposed wall ends, including tops of walls (parapets) must be covered to prevent water from infiltrating the wall assembly.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach sheathing to supporting construction.

- D. Installation Tolerances: Install sheathing to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 PANEL AND PENETRATION JOINT TREATMENT

- A. Panel Joint and Penetration Treatment for Long-Term Wind and Water Protection (Partially-Controlled Enclosure):
 - 1. Promptly after sheathing is installed, apply glass mesh joint tape to panel joints and penetrating items promptly after sheathing is installed.
 - 2. Center tape over sheathing panel joints and on perimeter openings surrounding penetrating items.
 - 3. Provide an overlap at intersections at least equal to the tape width.
 - 4. Apply at least a 3/8-inch continuous bead of sealant over the glass mesh joint tape, centered over sheathing panel joints; and to fasteners and perimeter of openings surrounding penetrating items.
 - 5. With a trowel, compress and embed the sealant into the entire surface of the tape creating a continuous, flat, and level surface.
 - 6. Fastener Treatment: Apply sealant or liquid flashing to each exposed fastener; trowel level and smooth.
- B. Alternate Panel Joint and Penetration Treatment: As an alternate to sealant and glass mesh tape, specified seam seal tape may be provided when applied to properly prepared and primed sheathing surfaces in conformance with the seam seal tape manufacturer's published installation instructions.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed sheathing in place from prolonged exposure to UV manufacturer's recommended limits, and other sources of deterioration and damage until covering. If exposed to UV for more than the recommended limit, then sheathing must be removed and replaced in conformance with the manufacturer's instructions.
- B. Do not store anything adjacent to or against installed sheathing unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed sheathing as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glue laminated wood beams.

1.2 RELATED REQUIREMENTS

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. AITC 117 - Standard Specifications for Structural Glued Laminated Timber of Softwood Species; 2010.
- B. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber; 2007.
- C. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions; 2012a.
- D. AWWA U1 - Use Category System: User Specification for Treated Wood; 2012.
- E. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2004, and supplements.
- F. WWPA G-5 - Western Lumber Grading Rules; 2011.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials, appearance, application technique and resultant performance information.
- C. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, framed openings .
- D. Manufacturer's Qualification Statement.
- E. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance with AITC A190.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protection during shipping, storage, and field handling members shall be in accordance with AITC 111.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Glued-Laminated Structural Units:
 1. Sentinel Structures, Inc: www.sentinelstructures.com/#sle.
 2. Western Wood Structures, Inc: www.westernwoodstructures.com/#sle.
 3. Substitutions: See Section 016000 - Product Requirements.

2.2 GLUED-LAMINATED UNITS

- A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Industrial grade.
 1. Verify dimensions and site conditions prior to fabrication.
 2. Cut and fit members accurately to length to achieve tight joint fit.
 3. Fabricate member with camber built in.
 4. Do not splice or join members in locations other than those indicated without permission.
 5. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

2.3 MATERIALS

- A. Lumber: Douglas-Fir lumber as indicated on structural drawings, conforming to WCLIB (GR) grading rules with 16 percent maximum moisture content before fabrication. Appearance grade to be Architectural.
- B. Laminating Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.

2.4 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWWA U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Preservative Pressure Treatment of Glued-Laminated members exposed to weather:
 - 1. Preservative Pressure Treatment of Glued-Laminated Structural Units: AWWA U1, Use Category UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
 - a. Kiln dry lumber after treatment and before lamination to maximum moisture content of 19 percent.
 - 2. Marking: Marked each piece with stamp of an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- C. Shop treat wood materials in accordance with manufacturer's instructions.

2.5 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.6 FABRICATION

- A. Fabricate glue laminated structural members in accordance with AITC Industrial grade.
- B. Verify dimensions and site conditions prior to fabrication.

- C. Cut and fit members accurately to length to achieve tight joint fit.
- D. Fabricate member with camber built in.
- E. Do not splice or join members in locations other than those indicated without permission.
- F. After end trimming, seal with penetrating sealer in accordance with AITC requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that supports are ready to receive units.
- B. Verify sufficient end bearing area.

3.2 PREPARATION

- A. Coordinate placement of support items.

3.3 ERECTION

- A. Lift members using protective straps to prevent visible damage.
- B. Set structural members level and plumb, in correct positions or sloped where indicated.
- C. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- D. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.
- E. Field Finishing: Specified in Section 099100.

3.4 TOLERANCES

- A. Framing Members: 1/4 inch maximum from true position.

END OF SECTION 061800

SECTION 06 20 00 – FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ready-made exterior and interior wood finish items.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 29 00 for definition of “permanent enclosure”.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. MMPA: Moulding & Millwork Producers Association.

B. Definitions:

1. Manufacturer: Means the finish carpentry manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:

1. Schedule finish carpentry deliveries to the project site only after the building is enclosed with a permanent enclosure; “wet work” within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install finish carpentry only after all other finishing operations are complete, especially overhead finishes.
3. After finish carpentry installation, maintain ambient conditions within design range until Final Completion.

B. Scheduling:

1. Acclimation: Allow sufficient time in the construction schedule to acclimate finish carpentry to specified ambient conditions for between 72 hours and 6 weeks before

installation begins, or until moisture content is not more than 8 percent, when measured with a moisture meter at specified ambient conditions.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. For manufactured items, submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned elevations drawn to scale and showing finish carpentry layout and types. Show locations, sizes, and extents of all finish carpentry and accessories.
 - b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions specific to the project. Cross-reference details to elevations.
 - c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
 - 3. Samples:
 - a. Submit at least one 8-inch long representative samples for each finish carpentry type, finish, and variety.
- B. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective finish carpentry with undamaged new finish carpentry that does not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.6 PROJECT CONDITIONS

- A. Existing Conditions:
1. Substrate Dimensional Tolerances: Surfaces receiving finish carpentry must be flat with 1/4-inch within any 10-foot radius.
 2. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.

3. Formaldehyde emissions criteria:

- a. Composite wood products to meet one of the following criteria per TPA TSCA Title VI or CARB ATCM.
 - 1) Ultra-low emitting formaldehyde (ULEF).
 - 2) No added formaldehyde resins (NAF).
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 STANDARD PROFILE BOARD PANELING

- A. Products: Indicated on the Drawings or selected by the Architect from MMPA Publication WM9, *"Industry Standard for Interior Wood Plank Paneling"*.
- B. Finish: Shop-applied opaque primer for field-applied finish.

2.3 ACCESSORIES

A. Wood Glue:

1. Description: Yellow aliphatic resin polyvinyl acetate (PVA) glue.
2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Elmer's Products Inc.
 - b. Franklin International.
 - c. Gorilla Glue, Inc.

3. Products: Provide the following manufactured by Franklin International, or equal.
 - a. Interior Grade Glue: "Titebond Original", or equal.
 - b. Exterior Grade Glue: "Titebond III Ultimate", or equal.
 - c. Moulding and Trim Glue: "Titebond Quick & Thick Mutisurface Glue", or equal.
- B. Construction Adhesive:
 1. Description: General purpose, indoor or outdoor, drillable, moisture resistant, sandable, heavy duty construction adhesive.
 2. Product: "Titebond PROvantage" manufactured by Franklin International, or equal.
- C. Finishing Nails:
 1. Description: 15-gage finish nails.
 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. DEWALT.
 - b. PORTER-CABLE.
 - c. SENCO.
 3. Requisite Properties:
 - a. Point Style: Chisel or diamond point.
 - b. Head Style: Brad.
 - c. Interior Application Finish: Electro-galvanized.
 - d. Exterior Application Finish: Stainless steel.
 - e. Coating: Sencote.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install finish carpentry using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Perform cutting and fitting as required or necessary for an accurate fit and complete installation.
4. Installed finish carpentry must be warrantable. Do not install, correct, or replace finish carpentry in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Shim using concealed shims.
2. Secure to ground, stripping, and blocking with countersunk, concealed fasteners and blind nailing as required for a satisfactory installation.
3. At gypsum board construction, anchor through wall surface to backing plates, blocking, or studs only.
4. Furnish fillers, closures and trim as required for a complete installation. Scribe in place where required.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach finish carpentry to supporting construction.

D. Installation Tolerances: Install finish carpentry to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;

2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed finish carpentry in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed finish carpentry unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed finish carpentry as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 06 40 16 – INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated trim.
2. Shop-fabricated interior custom wood doors.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. HPVA: Hardwood Plywood and Veneer Association.
2. MDF: Medium Density Fiberboard.
3. WI: Woodwork Institute.

B. Definitions:

1. Manufacturer: Means the panel or woodwork accessory manufacturer, as the context admits, unless otherwise indicated.
2. Fabricator: Means the woodwork fabricator, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:

1. Schedule woodwork deliveries to the project site only after the building is enclosed with a permanent enclosure; “wet work” within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install woodwork only after all other finishing operations are complete, especially overhead finishes.
3. After woodwork installation, maintain ambient conditions within design range until Final Completion.

B. Scheduling:

1. Acclimation: Allow sufficient time in the construction schedule to acclimate woodwork to specified ambient conditions for between 72 hours and 6 weeks before installation begins, or until moisture content is not more than 8 percent, when measured with a moisture meter at specified ambient conditions.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:

- a. For manufactured items, submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings:

- a. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions specific to the project.
- b. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.

3. Samples:

- a. Submit at least one 8-inch long or square representative fabrication sample for each woodwork type, color, finish, and variety, including core panel, facing, and edging.

B. Informational Submittals: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.

- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Quality Standards:

- 1. Plywood Standard: Provide hardwood and decorative plywood conforming to American National Standards Institute/ Hardwood Plywood and Veneer Association (HPVA) document ANSI/HPVA HP-1, "*American National Standard for Hardwood and Decorative Plywood*".
- 2. Woodworking Standard: Provide woodwork conforming to Architectural Woodwork Institute/ Architectural Woodwork Manufacturer's Association of Canada/ Woodwork Institute publication "*Architectural Woodwork Standards*" requirements for each specified Grade.

B. Qualifications:

- 1. Woodworkers and Finishers: Company or individuals must have at least 10 years' experience fabricating woodwork installed on at least 100 previous projects similar to this project in size, material, design, and complexity.
- 2. Installer: Company or individuals must have at least 5 years' experience installing woodwork for at least 30 previous projects similar to this project in size, material, design, and complexity.
- 3. Supervisors: Individuals must have at least 7 years' experience installing woodwork for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading woodwork installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

- 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
- 2. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

- 1. Furnish adequate dunnage and bracing during storage.
- 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
- 3. Do not leave items uncovered where they might become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.

C. Handling: Handle items in a manner that that prevents damage.

- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective woodwork with undamaged woodwork that does not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.
 - 3. Formaldehyde emissions criteria:
 - a. Composite wood products to meet one of the following criteria per TPA TSCA Title VI or CARB ATCM.
 - 1) Ultra-low emitting formaldehyde (ULEF).
 - 2) No added formaldehyde resins (NAF).

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 SOFTWOOD LUMBER

- A. Description: FSC-Certified dressed lumber, surface four sides (S4S) smooth without knife marks, unless otherwise indicated.
- B. Requisite Properties:
 - 1. Species: Indicated on the Drawings or selected by the Architect, or equal.
 - 2. Appearance Grade: Grade A.
 - 3. Finish: Transparent finish in conformance with the referenced woodworking quality standard, Section 5 requirements for System 12. (water-based polyurethane)
 - a. Stain: Indicated on the Drawings or selected by the Architect.
 - b. Sheen: Indicated on the Drawings or selected by the Architect.

2.3 HARDWOOD LUMBER

- A. Description: FSC-Certified dressed lumber, surface four sides (S4S) smooth without knife marks, unless otherwise indicated.
- B. Requisite Properties:
 - 1. Species: Indicated on the Drawings or selected by the Architect, or equal.
 - 2. Quality: Free of heart center (FOHC), unless otherwise indicated.
 - 3. Grade: FAS or SELECT, determined by size.
 - 4. Drying Designation: S-DRY. ("Surfaced Dry"; air dried to a moisture content less than 19 percent)
 - 5. Net Finished Dimensions: Indicated on the Drawings.
 - 6. Finish: Transparent finish conforming to the referenced woodworking quality standard, Section 5 requirements for System 12. (water-based polyurethane)
 - a. Stain: Indicated on the Drawings or selected by the Architect.
 - b. Sheen: Indicated on the Drawings or selected by the Architect.

2.4 COMPOSITE FIBER PANELS

- A. Medium-Density Fiberboard (MDF):
 - 1. Description: Composite fiber panels conforming to ANSI A208.2 and made from 100-percent post-industrial recycled wood fiber and having no added urea-formaldehyde resin.
 - 2. Products: Provide the following manufactured by Roseburg Forest Products Co., or equal.
 - a. Standard MDF: "Meditate II", or equal.
 - b. Moisture-Resistant MDF: "Medex", or equal.

- c. Flame-Resistant MDF: "Medite FR", or equal.
- 3. Requisite Properties:
 - a. Minimum Density: At least 50 pounds per cubic foot.
 - b. Nominal Thickness: At least 1/2-inch, unless otherwise indicated.
 - c. Minimum Grades:
 - 1) Thicknesses up to 3/8-inch: At least Grade 230.
 - 2) Thicknesses greater than 3/8-inch: At least Grade 150.

2.5 ACCESSORIES

- A. Wood Edgebanding and Profile Wrapping:
 - 1. Manufacturer: Provide products manufactured by The Cloverdale Co., or equal.
 - 2. Veneer Edgebanding: "BAND-IT Real Wood Edgebanding", or equal.
 - 3. Veneer Sheets: "BAND-IT Furniture Grade Veneer Sheets", or equal.
 - 4. Requisite Properties:
 - a. Species: Match veneer facing.
 - b. Width: 3/4- or 7/8-inch; or 2 inches as required.
 - c. Backing: Iron-on.
- B. Wood Glue:
 - 1. Description: Yellow aliphatic resin polyvinyl acetate (PVA) glue.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Elmer's Products Inc.
 - b. Franklin International.
 - c. Gorilla Glue, Inc.
 - 3. Products: Provide the following manufactured by Franklin International, or equal.
 - a. Interior Grade Glue: "Titebond Original", or equal.
 - b. Exterior Grade Glue: "Titebond III Ultimate", or equal.
 - c. Moulding and Trim Glue: "Titebond Quick & Thick Mutisurface Glue", or equal.
- C. Construction Adhesive:
 - 1. Description: General purpose, indoor or outdoor, drillable, moisture resistant, sandable, heavy duty construction adhesive.
 - 2. Product: "Titebond PROvantage" manufactured by Franklin International, or equal.
- D. Finishing Nails:
 - 1. Description: 15-gage finish nails.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. DEWALT.
 - b. PORTER-CABLE.
 - c. SENCO.
 - 3. Requisite Properties:

- a. Point Style: Chisel or diamond point.
 - b. Head Style: Brad.
 - c. Interior Application Finish: Electro-galvanized.
 - d. Exterior Application Finish: Stainless steel.
 - e. Coating: Sencote.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 FABRICATION

- A. Fabricate woodwork in conformance with AWI/AWMAC/WI quality standard publication requirements for Premium Grade.
- B. Fabricate items to the dimensions, profiles, and details shown, and in conformance with the specified quality standard requirements, unless otherwise noted or indicated.
 - 1. Shop-assemble work in as large units as practicable to minimize field cutting and jointing.
 - 2. Where necessary to fit at the project site, allow ample allowance for cutting and fitting. Create sufficient scribe where items intersect walls and partitions.
 - 3. Conceal means of fastening various items together.
 - 4. Assemblies must be free from open joints, hammer and machine marks, structural defects, and surface blemishes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify that in-place construction satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify deficient and non-conforming project conditions.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for woodwork installation.
2. Set woodwork true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
3. Shim as required with concealed shims.
4. Fit exposed connections accurately to form flush hairline joints

B. Special Techniques:

1. Install woodwork in a manner consistent with the specified grade; and plumb, level, true, and straight with no distortions.
2. Shim using concealed shims.
3. Secure to ground, stripping, and blocking with countersunk, concealed fasteners and blind nailing as required for a satisfactory installation.
4. At gypsum board construction, anchor through wall surface to wood blocking or wood studs only.
5. Furnish fillers, closures and trim as required for a complete installation. Scribe in place where required.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach woodwork to supporting construction.

D. Installation Tolerances: Install woodwork to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Remove from exposed woodwork surfaces anything that might interfere with uniform oxidation or weathering. Clean all visible woodwork surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed woodwork in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything in, on, adjacent to, or against installed woodwork unless it is protected from damage. Do not use installed woodwork as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 06 41 00 – ARCHITECTURAL WOOD CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop-fabricated wood cabinets and casegoods.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 81 00 for tempered glass for display case.
3. Section 10 99 00 for the glass enclosed display case doors.
4. Section 12 36 63 for solid surface material countertops.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. 2DL: 2D Laminate.
2. 3DL: 3D Laminate.
3. RTF: Rigid Thermoformable Foils
4. HPL: High-Pressure Laminate.
5. HPDL: High-Pressure Decorative Laminate.
6. TFL: Thermally-Fused Laminate.
7. CPA: Composite Panel Association.
8. HPVA: Hardwood Plywood and Veneer Association.
9. MDF: Medium Density Fiberboard.
10. NEMA: National Electrical Manufacturers Association.
11. WI: Woodwork Institute.

B. Definitions:

1. Manufacturer: Means plastic laminate, finish hardware, or accessory manufacturer, as the context admits, unless otherwise indicated.
2. Fabricator: Means the casework fabricator, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate casework finish hardware with adjacent door hardware finishes.
2. Coordinate casework design with countertops. Provide reinforcement as required to support countertops and backing. Countertops must not deflect to the point of cracking when subjected to in-service loads.

B. Shelving Performance Requirements:

1. Design Load: Shelving must support at least 50 pounds per square foot uniformly distributed load; not more than 200 pounds total load per shelf.
2. Deflection: Limit deflection under maximum design load to $L/144$, except that all shelving in the same room, or space must have the same thickness where not concealed by doors. Minimum shelving thickness must be at least 3/4-inch.
3. Permanent Deformation: No permanent deformation at maximum design load after 48 hours continuous loading.

C. Sequencing:

1. Schedule casework deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install casework only after all other finishing operations are complete, especially overhead finishes.
3. After casework installation, maintain ambient conditions within design range until Final Completion.

D. Scheduling:

1. Acclimation: Allow sufficient time in the construction schedule to acclimate casework to specified ambient conditions for between 72 hours and 6 weeks before installation begins, or until moisture content is not more than 8 percent, when measured with a moisture meter at specified ambient conditions.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: For manufactured items, submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:

- a. Submit dimensioned plans and elevations drawn to scale and showing casework layout and types. Show locations, sizes, and extents of all casework, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions specific to the project. Cross-reference details to plans and elevations.
 - c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
3. Samples: Submit at least one 8-inch square representative fabrication sample for each casework type, color, finish, and variety, including core panels, facings, and edgings.
- B. Informational Submittals: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
- C. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Operable parts for accessible casework must conform to the requirements of CBC Section 11B-309.
- B. Quality Standards:
 1. Woodworking Standard: Provide casework conforming to Architectural Woodwork Institute/ Architectural Woodwork Manufacturer's Association of Canada/ Woodwork Institute publication "*Architectural Woodwork Standards*" requirements for each specified Grade.
- C. Qualifications:

1. Woodworkers and Finishers: Company or individuals must have at least 10 years' experience fabricating casework installed on at least 100 previous projects similar to this project in size, material, design, and complexity.
2. Installer: Company or individuals must have at least 5 years' experience installing casework for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing casework for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading casework installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective casework with undamaged casework that does not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.

3. Formaldehyde emissions criteria:

- a. Composite wood products to meet one of the following criteria per TPA TSCA Title VI or CARB ATCM.
 - 1) Ultra-low emitting formaldehyde (ULEF).
 - 2) No added formaldehyde resins (NAF).
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 ARCHITECTURAL WOOD CASEWORK

- A. Cabinets and Caseworks: Faced panel casework conforming to the referenced woodworking quality standard, Section 10 requirements for Premium Grade, Construction Type A (frameless) single-length cabinet sections with Interface Style 1 (flush overlay) cabinet doors and drawers.

2.3 SOFTWOOD LUMBER

- A. Description: FSC-Certified dressed lumber, surface four sides (S4S) smooth without knife marks, unless otherwise indicated.
- B. Requisite Properties:
1. Species: Douglas fir.
 2. Appearance Grade: Grade B & Better.

2.4 FACED PANEL CONSTRUCTION

A. Plastic Laminate Facing and Edgebanding:

1. Description: High-pressure decorative laminate (HPDL) conforming to NEMA LD-3.
 - a. Exposed Surfaces: General purpose type HPDL Grade HGS. Toe bases are exposed surfaces, unless indicated as receiving an applied base. (e.g., a resilient base)
 - b. Semi-Exposed Surfaces: Finished laminate grade, no liners.
 - c. Concealed Surfaces: Backer type HPDL, Grade BKV.
2. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

B. Countertop Substrate Panels:

1. Description: Moisture-resistant composite fiber panels conforming to ANSI A208.2 and made from 100-percent post-industrial recycled wood fiber and having no added urea-formaldehyde resin.
2. Restrictions: Plywood, other than marine-grade plywood, is prohibited.
3. Products: "Medex" manufactured by Roseburg Forest Products Co., or equal.
4. Requisite Properties:
 - a. Minimum Density: At least 50 pounds per cubic foot.
 - b. Minimum Grade: At least Grade 150-MR 50.

C. Other Substrate Panels:

1. Description: Flame retardant composite fiber panels conforming to ANSI A208.2 and made from 100-percent post-industrial recycled wood fiber and having no added urea-formaldehyde resin.
2. Restrictions:
 - a. Plywood is prohibited for doors and drawers.
 - b. When accepted in writing by the Architect, plywood may be used for casework boxes. (accepted by WI, though not recommended)
3. Products: "Medite FR" manufactured by Roseburg Forest Products Co., or equal.
4. Requisite Properties:
 - a. Minimum Density: At least 50 pounds per cubic foot.
 - b. Nominal Thickness: At least 1/2-inch, unless otherwise indicated.
 - c. Minimum Grade: Grade 150.

2.5 FINISH HARDWARE

A. General:

1. Provide all hardware indicated, specified, and necessary for a complete installation.
2. Hardware finish must match the door hardware specified in Section 08 71 00, unless otherwise noted.

B. Manufacturers: Provide products manufactured by one of the following, or equal.

1. Accuride.

2. Blum, Inc.
 3. Doug Mockett & Co., Inc.
 4. Häfele America Co.
 5. Sugastune Corp.
- C. Pulls:
1. Description: Back-mounted pulls conforming to BHMA A156.9 Hardware Type No. A09021.
 2. Products: "DP3B/2 Series" pulls manufactured by Doug Mockett & Co., Inc., or equal.
 3. Requisite Properties:
 - a. Size: 4-inches.
 - b. Finish: Black.
- D. Hinges:
1. Description: Frameless concealed hinges (European cup style) conforming to BHMA A156.9, B01601 with integrated soft-close mechanism in the hinge cup. Spring-type self-closing hinges are prohibited.
 2. Product: "Salice Silentia Series" manufactured by Häfele America Co., or equal.
 3. Requisite Properties:
 - a. Provide hinges with between 95 and 100 degrees of opening for cabinets having retractable doors; and for cabinets next to walls or similar obstructions.
 - b. Provide hinges with between 100 and 120 degrees of opening for cabinets requiring additional cabinet access.
 - c. Provide hinges with between 165 and 175 degrees of opening for cabinets requiring the most cabinet access; and for installations where there are drawer pullouts in the cabinets.
 - d. Provide at least 3 hinges for doors at least 24 inches wide or at least 36 inches high.
 - e. Provide either screw- or rapido-mounted hinges.
- E. Retractable Pocket Door Slides:
1. Products: "Accuride Model 123/1234" manufactured by Häfele America Co., or equal.
 2. Requisite Properties:
 - a. Finish: Indicated on the Drawings or selected by the Architect.
- F. Full Extension Drawer Slides:
1. Description: Heavy Duty full extension slides conforming to BHMA A156.9 Hardware Type No. B05091, with decelerated closing
 2. Products: Provide the following supplied by Häfele America Co., or equal.
 - a. Light Duty Side Mount Slides: "Accuride 2632" slides, or equal.
 - b. Medium Duty Side Mount Slides: "Accuride 3832EC" slides, or equal.
 - c. Heavy Duty Side Mount Slides: "Accuride 3657" slides, or equal.
 - d. Medium Duty Bottom Mount Slides: "Accuride 3132EC Eclipse Easy-Close" slides, or equal.

- e. Heavy Duty S Bottom Mount Slides: "Accuride 9307" slides, or equal.
- 3. Grades:
 - a. Light Duty Slides: Provide BHMA-certified Grade 1, rated to at least 50 pounds per pair, for pencil drawers; and rated to at least 75 pounds per pair for general purpose drawers.
 - b. Medium Duty Slides: Provide BHMA-certified Grade 1HD-100, rated to at least 100-pounds per pair for file drawers up to 24 inches wide.
 - c. Heavy Duty Slides: BHMA-certified Grade 1HD-200, rated to at least 200 pounds per pair for lateral file drawers greater than 24 inches wide.
- 4. Mounting Style:
 - a. Provide side-mount slides for cabinet trays and drawers.
 - b. Provide bottom-mount slides for cabinet pullouts and heavy duty storage platforms.
- 5. Finish: Indicated on the Drawings or selected by the Architect.
- 6. Accessories: Provide stops to prevent accidental removal.
- G. Display Case Brackets:
 - 1. Product: "CRL Duranodic Bronze Anodized 36" Aluminum Wall Standard" manufactured by C.R. Laurence Co., Inc., or equal.
- H. Shelf Brackets:
 - 1. Description: Spoon-shaped 1/4-inch nickel-plated steel shelf supports.
 - 2. Product: "Item No. 282.04.739" manufactured by Häfele America Co., or equal.
- I. Locks:
 - 1. Description: Cylinder locks that separate the lock core from the cylinder housing, allowing any combination of locking systems.
 - 2. Product: "Cylinder Module System" manufactured by Häfele America Co., or equal.
 - 3. Requisite Properties:
 - a. All cabinet doors and drawers must be lockable.
 - b. Certain areas may be keyed separate. Everywhere else must be keyed the same.
 - c. Provide master keying.
 - d. Finish: Black.
- J. Grommets:
 - 1. Standard Grommet Liner and Cap: "MM5A" solid brass grommet liner (fits a 2-7/8-inch hole) and "MM5" solid brass grommet cap (fits a 2-3/4-inch hole).
 - 2. No Gap Small Grommets: "BRV1 Brava Grommet – Small", or equal (fits a 2-3/8-inch hole size).
 - 3. No Gap Large Grommets: "BRV2 Brava Grommet – Large", or equal (fits a 3-5/32-inch hole size).
 - 4. Trash Grommet: "TM-1 Steel" stainless steel trash grommet, or equal (fits a 6-inch hole size).
 - 5. Finish: Selected by the Architect to match adjacent surfaces.

2.6 ACCESSORIES

- A. Tempered Glass: Specified in Section 08 81 00.
- B. Base Cabinet Levelers:
 - 1. Description: 2-part adjuster and separate panel with steel spring clip screw-mounted to the toe kick panel.
 - 2. Products:
 - a. Adjuster: "Item No. 637.19.228" manufactured by Häfele America Co., or equal. (4-3/4- to 5-1/2-inch toe kick height)
 - b. Panel Clip: "Item No. 637.19.906" manufactured by Häfele America Co., or equal.
- C. Fixed Shelf Brackets:
 - 1. Description: Steel shelf supports.
 - 2. Product: "Hebgo Bracket" manufactured by Häfele America Co., or equal.
 - 3. Requisite Properties:
 - a. Minimum Sizes: Indicated on the Drawings or selected by the Architect.
 - b. Minimum Load Capacity: At least 300 pounds per pair.
 - c. Finished: Factory primed for a field-applied finish.
- D. PVC Edgebanding:
 - 1. Manufacturer: Provide products manufactured by Canplast, or equal.
 - 2. Product: Indicated on the Drawings or selected by the Architect, or equal.
 - 3. Color: Match laminate.
- E. Wood Glue:
 - 1. Description: Yellow aliphatic resin polyvinyl acetate (PVA) glue.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Elmer's Products Inc.
 - b. Franklin International.
 - c. Gorilla Glue, Inc.
 - 3. Products: Provide the following manufactured by Franklin International, or equal.
 - a. Interior Grade Glue: "Titebond Original", or equal.
 - b. Exterior Grade Glue: "Titebond III Ultimate", or equal.
 - c. Moulding and Trim Glue: "Titebond Quick & Thick Mutisurface Glue", or equal.
- F. Construction Adhesive:
 - 1. Description: General purpose, indoor or outdoor, drillable, moisture resistant, sandable, heavy duty construction adhesive.
 - 2. Product: "Titebond PROvantage" manufactured by Franklin International, or equal.
- G. Finishing Nails:
 - 1. Description: 15-gage finish nails.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.

- a. DEWALT.
- b. PORTER-CABLE.
- c. SENCO.
- 3. Requisite Properties:
 - a. Point Style: Chisel or diamond point.
 - b. Head Style: Brad.
 - c. Interior Application Finish: Electro-galvanized.
 - d. Exterior Application Finish: Stainless steel.
 - e. Coating: Sencote.
- H. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the fabricator for actual in-service conditions applicable to the project.
- I. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.7 FABRICATION

- A. Fabricate items to the dimensions, profiles, and details shown, and in conformance with the specified quality standards requirements, unless otherwise noted or indicated.
 - 1. Shop-assemble work in as large units as practicable to minimize field cutting and jointing.
 - 2. Where necessary to fit at the project site, allow ample allowance for cutting and fitting. Create sufficient scribe where items intersect walls and partitions.
 - 3. Conceal means of fastening various items together.
 - 4. Assemblies must be free from open joints, hammer and machine marks, structural defects, and surface blemishes.
- B. Finish Hardware:
 - 1. Accurately fit hardware and install in conformance with the manufacturer's instructions.
 - 2. Accurately fit doors and drawers with uniform clearance at all edges.
 - 3. Doors and drawers must operate freely, but not loosely, without sticking or binding, with all hardware adjusted and functioning properly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.

- B. Verification: Verify that in-place construction satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify deficient and non-conforming project conditions.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for casework installation.
 - 2. Set casework true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
 - 3. Shim as required with concealed shims.
 - 4. Fit exposed connections accurately to form flush hairline joints
- B. Special Techniques:
 - 1. Install casework in a manner consistent with the specified grade; and plumb, level, true, and straight with no distortions.
 - 2. Shim using concealed shims.
 - 3. Secure to ground, stripping, and blocking with countersunk, concealed fasteners and blind nailing as required for a satisfactory installation.
 - 4. At gypsum board construction, anchor through wall surface to wood blocking or wood studs only.
 - 5. Furnish fillers, closures and trim as required for a complete installation. Scribe in place where required.
- C. Interface with Adjacent Items:
 - 1. Provide materials, components, and accessories normally furnished or necessary to securely attach casework to supporting construction.
 - 2. Casework taller than 42 inches must be seismically anchored.
- D. Installation Tolerances: Install casework to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 ADJUSTING

- A. Verify smooth and quiet door, drawer, and finish hardware operation.
- B. Lubricate and adjust operating parts and finish hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Rehang or replace doors, drawers, and finish hardware that do not operate freely in a safe and reliable manner.

3.5 CLEANING

- A. Cleaning Work: Remove from exposed casework surfaces anything that might interfere with uniform oxidation or weathering. Clean all visible casework surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed casework in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything in, on, adjacent to, or against installed casework unless it is protected from damage. Do not use installed casework as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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DIVISION 07

THERMAL AND MOISTURE PROTECTION

SECTION 07 21 50 – BUILDING ENCLOSURE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stud bay concealed insulation.
2. Installation materials.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 07 54 19 for roof insulation.
3. Section 09 81 33 for acoustical insulation.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the insulation or accessory manufacturer, as the context admits, manufacturer, unless otherwise indicated.
2. Thermal Transmittance (U-value): Means the measure of heat flux (flow of energy per unit of area per unit of time) and is expressed in units of BTU per hour square foot degrees Fahrenheit of air to air temperature difference between the two sides of a material (Btu/sq. ft. x h x deg. F).
3. Thermal Resistance (R-value): Means the designation of an insulation material's resistance to heat flux. The R value is numerically equal to the reciprocal of the material's thermal transmittance, and is expressed in units of degrees Fahrenheit hour square foot per BTU inch at 75 degrees Fahrenheit (deg. F x h x sq. ft./Btu x in. at 75 deg. F).
4. Concealed: Means hidden behind other construction when complete; and exposed surfaces in areas designated as shelled spaces.
5. Exposed: Means remaining seen after construction is complete.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Fiberglass and mineral wool insulation may not be installed in direct contact with interior ventilation. Fiberglass and mineral wool insulation used in plenum spaces must be fully encapsulated.
 2. Plastic insulation must be separated from the building interior by a thermal/fire barrier that prevents the temperature rise to not more than 250 deg. F in a 15-minute time period.
 3. Both board insulation and spray applied foam insulation manufactured with blowing agents known to have ozone depleting potential (ODP) are prohibited.
- B. Performance Requirements: Above grade exterior perimeter walls must include insulation having a minimum R-value of at least R-21 for insulation material only, unless otherwise indicated.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Submit manufacturer-prepared published instructions for proper installation of furnished insulation.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.

- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped in their original packaging, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
- C. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.6 PROJECT CONDITIONS

- A. Existing Conditions: Surfaces receiving insulation must be dry.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.

- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.

2.2 MANUFACTURERS

- A. Fiberglass Blanket Insulation: Provide products manufactured by one of the following, or equal.
 - 1. CertainTeed Corp.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning Fiberglass Corp.
- B. Rock Wool Blanket Insulation: Provide products manufactured by one of the following, or equal.
 - 1. Fibrex Insulations, Inc.
 - 2. ROXUL, Inc.
 - 3. Thermafiber, Inc.

2.3 CONCEALED STUD BAY INSULATION

- A. Description: Asbestos-free mineral fiber blanket insulation conforming to ASTM C 665 requirements for Type I insulation (blankets without membrane coverings), manufactured from slag and naturally occurring rock.
- B. Mineral Wool Blanket Insulation: Provide one of the following, or equal.
 - 1. "COMFORTBATT" manufactured by ROCKWOOL International A/S.
 - 2. "Thermafiber UltraBatt" manufactured by Owens Corning.
- C. Requisite Properties:
 - 1. Minimum Thermal Resistance: Provide material having an R-value of at least R-4.0 per inch of thickness.
 - 2. Minimum Size: Provide sizes required for a self-supporting friction fit.
 - 3. Minimum Thickness: 6 inches.
 - 4. Minimum Density: 2.0 pounds per cubic foot.
 - 5. Facing: None.

2.4 INSTALLATION MATERIALS

- A. Insulation Hangers:
 - 1. Application: Used to attach insulation to clean, dry, smooth, non-porous solid surfaces.
 - 2. Manufacturer: Provide products manufactured by AGM Industries, Inc., or equal.
 - 3. Products: Provide the following, or equal.

- a. Anchors: "TACTOO Insul-Hangers" adhesively attached spindle-type anchors.
 - b. Adhesive: "BOSS 348 Multi-Purpose Construction Adhesive" manufactured by Accumetric, LLC or other VOC-compliant insulation hanger adhesive.
 - c. Insulation Standoff: One-inch "Clutch Clip".
 - d. Insulation Retaining Washers: "Style RC 200" round or "SC 250" square washers.
4. Requisite Properties:
- a. Base Plate and Insulation Standoff and Retaining Washers: At least 2-inch square by at least 0.149-inch (MSG 28) base metal thickness galvanized perforated steel sheet.
 - b. Retaining Washers: At least 1-1/2-inch square or diameter by at least 0.149-inch (MSG 28) base metal thickness galvanized perforated steel sheet.
 - c. Spindle: At least 0.106-inch diameter (SWG 12), zinc-coated wire, depth to suit depth of insulation indicated.
 - d. Adhesive: Adhesive used with impaling pins must either be manufactured or accepted by the insulation hanger manufacturer. "Peel and press" hangers with self-adhering adhesive backings are prohibited.
- B. Mechanical Fasteners: Tape, staples, and other devices for fastening insulation supplied, required, recommended, or accepted by the insulation manufacturer.
- C. Hanger Wire: At least 0.106-inch diameter (SWG 12) soft temper zinc-coated wire conforming to ASTM A 641, Class 3 or A coating.
- D. Adhesive: Supplied, required, recommended, or accepted by the insulation manufacturer to bond insulation securely to substrates indicated without damaging insulation or substrates.
- 2.5 ACCESSORIES
- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install insulation using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Extend insulation to envelop entire area insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
3. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
4. Installed insulation must be warrantable. Do not install, correct, or replace insulation in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Stud Bay Insulation: Install insulation in cavities formed by framing members.
 - a. Use insulation that fills the cavities. If more than one length is required to fill the cavities, then provide lengths that will produce a snug fit between ends.
 - b. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - c. Maintain 3-inch clearance around recessed lighting fixtures not rated for or protected from contact with insulation.
 - d. Stuff loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to roughly 40 percent of normal maximum volume.
 - e. For metal-framed wall cavities higher than 96 inches, support unfaced blankets mechanically and support faced blankets by taping insulation flanges to metal stud flanges.
2. Ceiling Insulation:
 - a. Install blanket insulation above ceilings where indicated.
 - b. Maintain 3-inch clearance of insulation around recessed lighting fixtures.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach insulation to supporting construction.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed insulation in place from becoming wet, deterioration, and damage until covering.
- B. Do not store anything adjacent to or against installed insulation unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed insulation as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 07 25 13 – SHEET WEATHER-RESISTIVE BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polyethylene sheet weather-resistive barriers.
2. Asphalt-saturated sheet weather-resistive barriers.
3. Self-adhering sheet flashings integral to sheet weather-resistive barriers.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
2. Section 06 16 43 for treatment of sheathing panel joints.
3. Section 07 65 26 for through-wall, opening, penetration, and transition SASM flashings, installation materials, and accessories not integral to WRB installation.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. WRB: Weather-Resistive Barrier.
2. VDR: Vapor Diffusion Retarder.
3. AB: Air Barrier.
4. UV: Ultraviolet Solar Radiation.

B. Definitions:

1. Manufacturer: Means the WRB manufacturer, unless otherwise indicated.
2. Perm: Means a U.S. perm, or unit of permeance (water vapor transmission) at a given differential in partial pressures on either side of a material or membrane. The U.S. perm is defined as one grain of water vapor per hour, per square foot, per inch of mercury. One US perm is equivalent to 0.659045 metric perms.
3. Shiner: Means lath or accessory fasteners that miss framing members.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: A preinstallation meeting is required for specified warranty.

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.

2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, or performance of installed WRBs. Resolve each condition.
 4. Finalize construction schedule.
 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- B. Sequencing:
1. Install WRBs only after penetrating items are installed.
 2. Install WRBs only after openings are framed.
- C. Scheduling:
1. UV Exposure: Schedule installation to keep WRB exposure to UV within the manufacturer's recommended limits.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Shop Drawings:
 - a. Submit dimensioned drawings showing joints, seams, tie-ins, and dimensions, including terminations, penetrations, coves, interior and exterior corner conditions, openings, and expansion joints.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished WRBs.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
 3. Manufacturer's Representative Reports:
 - a. Before beginning work, request and submit reports confirming substrates are properly prepared in conformance with manufacturer's instructions and other requirements and recommendations; are acceptable and satisfactory to receive the work of this specification section; and conform to all requirements necessary to issue specified and other warranties.
 - b. During the work, request and submit reports documenting actions taken by the manufacturer's representative to verify conformance with manufacturer's instructions and other requirements and recommendations.
 - c. Upon completion, request and submit reports confirming installed roofing conforms to all requirements necessary to issue specified and other warranties.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. WRBs must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing WRBs installed on at least 200 previous projects similar to this project in size, material, design, and complexity.

2. Installer: Company or individuals must have at least 5 years' experience installing WRBs for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing WRBs for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading WRB installers.
 4. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in size, material, design, and complexity.
- C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate WRBs into the mockup as part of the work of this specification section.
- D. Field Samples: Include *in-situ* mockups as part of the work of this specification section.
1. Install at least one 100-square-foot field sample of each WRB installation to verify selections made under sample submittal and to set quality standards for installation. Demonstrate surface preparation, crack repair, and joint, and corner preparation.
 2. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
 3. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of WRB is made from field samples.
 4. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
 5. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
 3. If items are not stored in an enclosed location, then cover the tops and sides of stored items with securely-tied, waterproof, breathable covers. Unvented polyethylene

tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath the tarpaulin during certain environmental conditions)

4. Incline covered items to ensure maximum drainage of accumulated moisture.
 5. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to heat, sudden changes in temperature, and UV exposure beyond the manufacturer's limits; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions:
1. Do not install WRBs during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
- B. Existing Conditions: Surfaces over which WRBs are installed must be dry. Install WRBs only when substrate moisture content falls within ranges required, recommended, or accepted by the manufacturer.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 10 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 POLYETHYLENE SHEET WRB

- A. Description: Non-woven, non-perforated, non-absorbing, breathable spunbonded HDPE WRB that that
 - 1. resists air flow, bulk water, and wind driven rain;
 - 2. channels water and moisture to the outside of the building envelope; and
 - 3. has a current evaluation report from the NES or ICC-ES demonstrating code compliance when installed as a WRB.
- B. Application: Installed on the exterior side of exterior building walls directly over the exterior wall sheathing as the base layer primary WRB. Windows, doors, and other openings must be flashed to this layer.
- C. Products: "Tyvek CommercialWrap" (ICC-ES Report No. ESR-2375) manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- D. Requisite Properties:
 - 1. Minimum Basis Weight: At least 2.7 ounces per square yard, when measured in conformance with TAPPI Test Method T 410.
 - 2. Minimum Roll Width: 10 feet.
 - 3. Maximum UV Exposure Limit: Cover within 365 days.
- E. Performance Requirements:
 - 1. Maximum Water Vapor Permeance: Not more than 23 perms, when measured in conformance with ASTM E 96, Procedure A.
 - 2. Minimum Water Resistance: At least 280, when tested in conformance with AATCC 127.
 - 3. Minimum Tensile Strength: At least 35 lbf per inch, when tested in conformance with ASTM D 882.
 - 4. Surface-Burning Characteristics: wall surfacing having a maximum FSI Value of 10 or less and a maximum SDI Value of less than 10 (Class A), when tested in conformance with ASTM E 84.
- F. Accessories:
 - 1. Prefabricated Penetration Flashings: Provide products manufactured by Quickflash Weatherproofing Products, Inc.
 - 2. Primer: Supplied, recommended, or accepted by the manufacturer for each substrate.
 - 3. Straight Flashing Material:
 - a. Description: 30-mil thick self-adhering flashing material with an elasticized polyethylene laminate face coated with butyl adhesive.
 - b. Application: Applied to rectangular window flanges, sill plates, corners, and joints.
 - c. Product: "StraightFlash", or equal,

- d. UV Exposure Limit: Cover within 120 calendar days.
- 4. Flexible Flashing Material:
 - a. Description: 70-mil thick self-adhering elastic flexible flashing tape with a spunbonded polyethylene laminate face coated with butyl adhesive.
 - b. Application: Applied to recessed and curved window flanges, sill plates, corners, and joints.
 - c. Product: "FlexWrap NF", or equal.
 - d. UV Exposure Limit: Cover within 120 calendar days.
- 5. Seam Tape:
 - a. Description: Oriented polypropylene film coated with acrylic adhesive
 - b. Product: "Tyvek Tape", or equal.
- 6. Transition Flashing Material:
 - a. Description: Used where WRB transitions to another system or parapet.
 - b. Products: Specified in Section 07 65 26.
- 7. Fasteners:
 - a. Metal Stud Construction: "Tyvek Wrap Cap" fastening system, including "Wrap Cap Screws" and 2-inch diameter "Wrap Cap" HDPE washers.
 - b. Wood Stud Construction: "Tyvek Wrap Cap" fastening system, including #4 nails with large one-inch plastic cap fasteners.
- 8. Primer, Adhesive, and Other Accessories: Provide primer, adhesive, and other accessories and similar secondary items supplied, required, recommended, or accepted by the manufacturer and as necessary for a complete installation.

2.2 ASPHALT-SATURATED SHEET WRB

- A. Description: Weather-resistant building paper conforming to Federal Specification FS UU-B-790a Type I (barrier paper), Grade D (water vapor permeable), Style 2 (uncreped, not reinforced, saturated) and having a current evaluation report from the NES or ICC-ES demonstrating code compliance when installed as a WRB.
- B. Application: Installed on the exterior side of exterior building walls directly behind exterior Portland cement plaster to separate the plaster assembly from the base layer WRB.
- C. Products: Provide one of the following, or equal.
 - 1. "Davis Wire 60 Minute" (ICC-ES Report No. ESR-2595) manufactured by Davis Wire Corp.
 - 2. "Super Jumbo Tex 60 Minute" (ICC-ES Report No. ESR-1027) manufactured by Fortifiber Corp.
 - 3. "GMCraft 60 Minute" (ICC-ES Report No. ESR-2376) manufactured by GMC Roofing & Building Paper Products, Inc.
- D. Requisite Properties:

1. Minimum Basis Weight: At least 6 pounds per 100 square feet (approximately 9.0 ounces per square yard).
2. Minimum Roll Width: At least 40 inches.
3. Maximum UV Exposure Limit: Cover within 30 days.

E. Performance Requirements:

1. Minimum Water Vapor Permeance: At least 5 perms, when measured in conformance with ASTM E 96, Procedure B.
2. Minimum Water Resistance: At least 60 minutes, when tested in conformance with ASTM D 779.
3. Minimum Tensile Strength: At least 70 lb^f per inch, when tested in conformance with ASTM D 882.

F. Accessories:

1. Fasteners: At least one-inch-long, 16-gage, pneumatically-applied, coated galvanized steel crown staples
2. Sealing Material, Repair Tape, and Other Accessories: Provide mastic, adhesive, pressure-sensitive adhesive tape, and other items supplied, required, recommended, or accepted by the manufacturer and compatible with base layer WRB where in contact.

2.3 ACCESSORIES

A. Sealant:

1. Description: Silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 25.
2. Product: "758" manufactured by Dow Corning Corp., or equal.
3. Color: White.

B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect

the quality of installation or the durability, appearance, or performance of installed and adjacent items.

2. Verify substrates are dry and free of deleterious and other substances that might interfere with WRB installation or performance.
3. Verify items penetrating WRBs are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install WRBs using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed WRBs must be warrantable. Do not install, correct, or replace WRBs in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Placing:
 - a. Start weather barrier installation at a building corner, leaving 6-12 inches of weather barrier extended beyond corner.
 - b. Starting at the bottom of the wall, install WRB horizontally over sheathing and securely attach with a minimum of fasteners.
 - c. Lap WRB in shingle fashion at least 3 inches at horizontal seams, and 6 inches at vertical seams. Stagger vertical joints. Shingle horizontal joints. Continuously tape all seams.
 - d. To prevent direct contact between metal lath and accessories, and to ensure water tightness, lap the WRB over flanges of plaster accessories. Continue weather barrier uninterrupted behind plaster control joints.
 - e. At areas to receive plaster provide asphalt saturated sheet WRB over base layer WRB, installed in conformance with the manufacturer's instructions.
 - f. At areas where base layer WRB might be permanently exposed to UV light, provide UV stable sheet installed in conformance with the manufacturer's instructions.
 - g. Integrate base layer WRB with flashing materials at windows, doors, and other penetrations to properly discharge water to the exterior face of the wall. Omitted or improperly installed flashing must be corrected prior to installing the WRB.

- h. Seal all joints and penetrations through the WRB with flashing tape.
 - i. Continuously tape WRB at window and door openings, and to through-wall flashings.
 - 2. Attachment: Fasten WRBs tight to substrates without wrinkles.
 - 3. Penetrations: To create an airtight seal between penetrating items and WRBs, seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating WRBs with vapor-retarder tape.
 - a. Cut WRB to fit closely and neatly.
 - b. Continuously seal edges around penetrations.
 - 4. Cladding Anchors: Apply 4- by 9-inch piece of approved flashing membrane to weather barrier membrane prior to the installation cladding anchors. Seal edges with weather barrier sealant.
 - 5. Follow polyethylene sheet WRB manufacturer's instructions for WRB installations greater than 4 stories for the primary WRB.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to attach WRB tight and flat with as few fasteners as possible, and only enough to hold the WRB in place until the final wall finish material is installed.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer Services: Installed work is subject to examination by the manufacturer's representative to determine conformance to manufacturer's instructions and other requirements and recommendations. Manufacturer's field representative services are required for specified warranty.
 - 1. Note all defective items and non-conforming work identified by the manufacturer's representative.
 - 2. Itemize into a punch list all noted items and record the manufacturer's requirements and recommendations for correcting each punch list item.
 - 3. Promptly bring all punch list items into conformance with the manufacturer's requirements and recommendations until accepted in writing by the Architect.
 - 4. Manufacturer's representative withholds issuing warranties until all punch list items are accepted by the Architect.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
 - 1. WRB Repair: Repair tears, holes and other damage with tape; or if too large, with at least 12-inch wide strips or remnants of WRB material centered over damaged areas and at least 6 inches larger all around, whichever is greater.
 - a. Continuously tape or seal top layer edges of repair material to bottom layer.
 - b. WRB must be free from holes, tears, and punctures at the end of installation.

2. Shiner Repair:

- a. Shiners are discovered by the installer as they miss the framing or observed from the interior before drywall is installed.
- b. Shiners must be removed, and WRB and sheathing holes filled with compatible sealant prior to patching WRB with compatible self-adhesive flashing.
- c. Do not leave shiners in place and seal over or rely on sealant as the only patching method.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

A. Protect installed WRBs in place from prolonged exposure to UV manufacturer's recommended limits, exposure to weather, becoming wet, contact with damp or wet surfaces, and other sources of deterioration, and damage until covering. If exposed to UV for more than the recommended limit, then WRBs must be removed and replaced in conformance with the manufacturer's instructions.

B. Do not store anything adjacent to or against installed WRBs unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed WRBs as work surfaces.

C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 07 25 23 – FLUID-APPLIED WEATHER RESISTIVE BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fluid-applied weather resistive barriers.
 - 2. Surface preparation.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.

1.2 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. WRB: Weather-Resistive Barrier.
 - 2. VDR: Vapor Diffusion Retarder.
 - 3. AB: Air Barrier.
 - 4. UV: Ultraviolet Solar Radiation.
- B. Definitions:
 - 1. Manufacturer: Means the WRB manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified WRBs are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 - 2. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.

- B. Preinstallation Meeting: A preinstallation meeting is required for specified warranty.
 - 1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 - 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 - 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, or performance of installed WRBs. Resolve each condition.
 - 4. Finalize construction schedule.
 - 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- C. Sequencing:
 - 1. Substrate repairs must be completed after surface preparation.
 - 2. Install WRBs only after penetrating items are installed and after openings are framed.
- D. Scheduling:
 - 1. Primer Installation: WRBs must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
 - 2. UV Exposure: Schedule installation to keep WRB exposure to UV within the manufacturer's recommended limits.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished WRBs.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.

- b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. WRBs must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. WRBs must be obtained only from a manufacturer that sends a representative to the project site before beginning work to verify existing conditions; and during work to perform manufacturer's field services.
 - 3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Qualifications:
 - 1. Installer: Company or individuals must have at least 5 years' experience installing WRBs for at least 30 previous projects similar to this project in size, material, design, and complexity.
 - 2. Supervisors: Individuals must have at least 7 years' experience installing WRBs for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading WRB installers.
 - 3. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in size, material, design, and complexity.
- C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate WRBs into the mockup as part of the work of this specification section.
- D. Field Samples: Include *in-situ* mockups as part of the work of this specification section.
 - 1. Install at least one 100-square-foot field sample of each WRB membrane installation to verify selections made under sample submittal and to set quality standards for

installation. Demonstrate surface preparation, crack repair, and joint and corner preparation.

2. Test WRB membrane adhesion to verify surface preparation.
3. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
4. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of WRBs is made from field samples.
5. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
6. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
 1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective WRB materials with undamaged new WRB materials that do not exhibit deterioration, damage, or defects.

- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install WRBs only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
 - 1. Do not install WRBs during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 - 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
 - 3. Apply only as much WRB as can be made weathertight each day, including all flashing and detail work. Apply uninterrupted waterstops at the end of each day's work, and completely remove them before proceeding with the next day's work.
- B. Existing Conditions: Surfaces receiving WRBs must be dry. Install WRBs only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
- C. Other Conditions: Do not apply WRBs where dust is generated, or liquids are sprayed.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 10 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED WRB

- A. Products: "Tyvek Fluid Applied WB+" manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- B. Requisite Properties:
 - 1. Minimum Thickness: At least 90 mils (wet).
 - 2. Maximum UV Exposure Limit: Cover within 240 days.

C. Performance Requirements:

1. Minimum Elongation: At least 300 percent, when tested in conformance with ASTM D 412.
2. Minimum Tensile Strength: At least 140 pounds per square inch, when tested in conformance with ASTM D 412.
3. Maximum Permeance: Not more than 22 perms, when tested in conformance with ASTM E 96, test method B.
4. Minimum Peel Strength:
 - a. CMU Substrates: At least 10 pounds per inch, when tested in conformance with ASTM D 903.
 - b. GMF Sheathing Substrates: At least 25 pounds per inch before glass facing pulls away from gypsum core, when tested in conformance with ASTM D 903.
5. Maximum Air Permeance of In-Place Membrane: Not more than 0.0002 cfm per square feet, when tested in conformance with ASTM E 2178 at a test pressure 1.57 pounds per square foot.

2.2 ACCESSORIES

- A. Primer for Flashings: "DuPont Adhesive Primer" manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- B. Conformable Weather Barrier Flashing: "FlexWrap NF" manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- C. Strip Flashing: "Tyvek StraightFlash VF" manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- D. Fluid Applied Flashing: "Tyvek Fluid Applied Flashing and Joint Compound+" manufactured by E.I. DuPont de Nemours & Co. (Dupont), or equal.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.3 MIXING

- A. Open WRB containers only as required for use.
- B. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- C. Do not reduce, alter, or introduce foreign materials into WRB material, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with WRB adhesion or performance.
 - 3. Verify items penetrating WRBs are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and WRB installation.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
- B. Substrate Preparation:
 - 1. Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 - 2. Remove substrate coatings and other substances that may negatively affect the quality of the installation, durability, or performance of furnished WRBs.
 - 3. Remove substrate ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface.

3.3 INSTALLATION

A. General Requirements:

1. Install WRBs using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install WRBs under conditions that ensure WRB membrane is free from defects.
3. Provide smooth surfaces of uniform finish, appearance, and coverage. WRB surfaces with spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed WRBs must be warrantable. Do not install, correct, or replace WRBs in a manner that results in any warranty or guarantee becoming void.

3.4 CORRECTION AND REPAIR

- #### A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- #### B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- #### C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- #### A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.

3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed WRBs in place from prolonged exposure to UV manufacturer's recommended limits, exposure to weather, becoming wet, contact with damp or wet surfaces, and other sources of deterioration, and damage until covering WRBs. If exposed to UV for more than the recommended limit, then WRBs must be removed and replaced in conformance with the manufacturer's instructions.
- B. Do not store anything on, adjacent to, or against installed WRBs unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed WRBs as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 07 26 13 – BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Underslab vapor diffusion retarders.
2. Installation materials.
3. Trenching repair.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
2. Section 03 35 10 for concrete screeds.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. WRB: Weather-Resistive Barrier.
2. VDR: Vapor Diffusion Retarder.
3. AB: Air Barrier.
4. SASM: Self-Adhering Sheet Membrane.
5. UV: Ultraviolet Solar Radiation.
6. Definitions:
7. Manufacturer: Means the VDR manufacturer, unless otherwise indicated.
8. Perm: Means a U.S. perm, or unit of permeance (water vapor transmission) at a given differential in partial pressures on either side of a material or membrane. The U.S. perm is defined as one grain of water vapor per hour, per square foot, per inch of mercury. One US perm is equivalent to 0.659045 metric perms.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:

1. VDR manufacturer's representative and VDR installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, VDR manufacturer's representatives and VDR installers, and the entities and individuals responsible for placing concrete reinforcing and pouring concrete.

3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
 4. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 5. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, or performance of installed VDRs. Resolve each condition.
 6. Finalize construction schedule.
 7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- B. Sequencing: Install VDRs only after penetrating items are installed.
- C. Scheduling: Schedule installation to keep VDR exposure to UV within the manufacturer's recommended limits.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data VDRs (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished VDRs.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. VDRs must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. VDRs must be obtained only from a manufacturer that sends a representative to the project site before beginning work to verify existing conditions; and during work to perform manufacturer's field services.
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing VDRs installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Installer: Company or individuals must have at least 5 years' experience installing VDRs for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing VDRs for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading VDR installers.
4. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in size, material, design, and complexity.

C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate VDRs into the mockup as part of the work of this specification section.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.

1. Prevent stored items from contacting the floor or ground and from deterioration and damage.

2. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
 3. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 4. Incline covered items to ensure maximum drainage of accumulated moisture.
 5. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective VDR materials with undamaged new VDR materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions:
1. Do not install VDRs during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Fortifiber Corp.
 2. Raven Industries.
 3. Reef Industries.
 4. Stego Industries, LLC.

2.2 EXTRUDED PLASTIC VDRs

- A. Description: Virgin extruded polyolefin VDR that exceeds ASTM E 1745 requirements for minimum performance Class A VDRs.
- B. Products: "Stego Wrap (15-Mil) Vapor Barrier" manufactured by Stego Industries, LLC, or equal.
- C. Requisite Properties:
 - 1. Minimum Thickness: Actual thickness must be at least 15 mils.
 - 2. Maximum UV Exposure Limit: Cover within 30 days.
- D. Performance Requirements: VDRs must maintain performance requirements specified below after testing in conformance with ASTM E 1745, Sections 7.1.1 to 7.1.5.
 - 1. Maximum Water Vapor Permeance: Not more than 0.01 perms, when measured in conformance with ASTM F 1249.
 - 2. Minimum Tensile Strength: At least 55 pounds per inch, when measured in conformance with ASTM D 882.
 - 3. Minimum Puncture Resistance: At least 2,300 grams, when tested in conformance with ASTM D 1709, Method B.

2.3 INSTALLATION MATERIALS

- A. Seaming Tape:
 - 1. Description: 4-inch wide by at least 6-mil thick polyethylene tape with rubber-based pressure-sensitive adhesive
 - 2. Product: "Stego Tape" manufactured by Stego Industries, LLC, or equal
- B. Sealing Tape:
 - 1. Description: Non-hardening and flexible double-sided butyl rubber tape
 - 2. Applications: Used to join VDR layers together by overlapping the edges and installing tape in between; and adhere VDR to concrete walls and footings.
 - 3. Product: "StegoTack Tape" manufactured by Stego Industries, LLC, or equal.
- C. Sealant: Elastomeric sealant supplied, required, recommended, or accepted by the manufacturer, and that is both chemically and adhesively compatible with the selected VDR.

2.4 ACCESSORIES

- A. Termination Bar: "Stego Term Bar", or equal, used for mechanically securing VDR to concrete, wood, or masonry.
- B. Concrete Bond Tape: "Stego Crete Claw", or equal, used to seal Stego Wrap to concrete while the concrete is still wet..

- C. Mastic: "Stego Mastic", or equal, used for sealing utility and pipe penetrations.
- D. Pipe Boots: Precut pipe boots with stretchable butyl adhesive tape, or equivalent products supplied, required, recommended, approved, or accepted by the manufacturer.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify substrates are dry and free of deleterious and other substances that might interfere with VDR installation or performance.
 - 3. Verify items penetrating VDRs are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install VDRs using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Installed VDRs must be warrantable. Do not install, correct, or replace VDRs in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:

1. Repair tears, holes and other damage with tape; or if too large, with at least 12-inch wide strips or remnants of VDR material centered over damaged areas and at least 6 inches larger all around in all directions, whichever is greater.
2. Continuously tape or seal top layer edges of repair material to bottom layer.
3. VDR must be free from holes, tears, and punctures at the end of installation.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed VDRs in place from prolonged exposure to UV manufacturer's recommended limits, exposure to weather, becoming wet, contact with damp or wet surfaces, and other sources of deterioration, and damage until covering. If exposed to UV for more than the recommended limit, then VDRs must be removed and replaced in conformance with the manufacturer's instructions.
- B. Do not store anything on or adjacent to installed VDRs unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed VDRs as work surfaces.
- C. Remove protection when it's no longer needed and before covering. Examine VDR before concrete placement and repair any damages including punctures, tears, and unadhered tape.

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SECTION 07 41 13 – METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof panels.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the roof panel manufacturer, unless otherwise indicated.
2. Failure: Includes noise or vibration caused by movement, material deterioration beyond normal weathering, and water leakage through roof panel and framing areas.
3. Water Leakage: Means penetration of water onto the exposed inside surface of the test specimen under specified conditions of air pressure difference across the specimen during a 15-min test period. Water penetration at or around end dams or side rails is not leakage; end dams and side rails are installed to cause and control ponding over the panels and to support the panels. They are not part of the roof.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate building opening tolerances with roof panel manufacturing and erection tolerances. The manufacturer must accommodate building frame tolerances.

B. Performance Requirements:

1. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, *"Minimum Design Loads and Associated Criteria for Buildings and other Structures"*.
2. Design Wind Rating: Roof panel assemblies must conform to UL 580 Class 90 wind uplift requirements.
3. Clip and Panel Performance: Clip and panel components must resist design pressures, when panel bending and clip-to-panel strength are tested in conformance with ASTM E 1592.

4. Panel Deflection: Individual roofing panels may not deflect more than $L/180$ measured normal to the panel plane, when tested in conformance with ASTM E 1592.
 5. Permanent Deformation: Individual roofing panels may not deform, buckle, or exhibit side lap separation when subjected to a 300-pound concentrated load applied to a 4-square-inch area located between supports at panel mid-span and center.
 6. Air Leakage (AL): Maximum permanent AL rating of not more than 0.06 cubic feet per minute per square foot, when tested in conformance with ASTM E 1680 at 1.57 pounds per square foot minimum differential static air pressure in sequence with or before water leakage testing.
 7. Water Leakage: No water leakage through the assembly or joints, when tested in conformance with ASTM E 1646 at the following differential pressures.
 - a. Less than or Equal to 30 Degrees from Horizontal: 2.86 pounds per square foot minimum differential pressure.
 - b. Steeper than 30 Degrees from Horizontal: 20 percent of the positive design wind pressure but not less than 6.24 nor more than 12 pounds per square foot minimum differential pressure.
 8. Hydrostatic Head Resistance: No water leakage, when tested in conformance with both ASTM E 2140.
 9. Solar Energy Performance Requirements:
 - a. Minimum Solar Reflectance Index (SRI) Value: At least SRI 0.75 for low-slope roofs (less than 2:12 slope) and 0.16 for steep slope roofs (greater than or equal to 2:12 slope), when measured in compliance with ASTM E 1918.
 - b. Minimum Aged Reflectance Value: At least 0.63 for low-slope roofs (less than 2:12 slope) and 0.20 for steep slope roofs (greater than or equal to 2:12 slope), when maintained under normal conditions and measured in conformance with ASTM E 1918.
 - c. Minimum Emittance Value: At least 0.75, when measured in conformance with ASTM C 1371.
 10. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
 11. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified in Section 05 50 00.
- C. Preinstallation Meeting:
1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed roof panels. Resolve each condition.
 4. Finalize construction schedule.

5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing roof panel layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
 3. Samples:
 - a. Submit at least 6-inch long by full panel width representative samples of each roof panel type, color, finish, and variety.
 - b. Submit at least 6-inch long representative samples of each accessory and trim type, color, finish, and variety. Include fasteners and exposed accessories.
 - c. Submit samples of all supporting framework components (e.g. rails, clips, brackets, subgirts), necessary for a complete installation.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished roof panels.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Roof panels must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Regulatory Requirements:
 - 1. Fire Resistance Rating: Roof coverings must conform to UL 790 fire resistance requirements for Class A rating. (effective against severe fire test exposures)
- C. Qualifications:
 - 1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing roof panels installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
 - 2. Installer: Company or individuals must have at least 5 years' experience installing roof panels for at least 30 previous projects similar to this project in size, material, design, and complexity.

3. Supervisors: Individuals must have at least 7 years' experience installing roof panels for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading roof panel installers.
4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective roof panels with undamaged new roof panels that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years; and for finishes against color fading, chalking, cracking, checking, peeling, and adhesive failure for 20 years.

- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. AEP Span.
 - 2. CENTRIA, Inc.
 - 3. Metal Sales Manufacturing Corp.
 - 4. Morin.
 - 5. NorthClad.
 - 6. Steelogic LLC.
- B. Fabricators: Shop-fabricated panels are prohibited.

2.3 ROOF PANELS

- A. Description: Pre-finished, formed metal roofing panels with vertical panel edges, flat panel between panel edges, and standing seam joints between panels.
- B. Restrictions: Minimum slope must be at least 2:12.

- C. Product: "Design Span hp" manufactured by AEP SPAN, or equal.
- D. Requisite Properties:
 - 1. Sizes: Indicated on the Drawings.
 - 2. Material Thickness: At least 0.032-inch thick pre-painted aluminum sheet.
 - 3. Coverage: 12 inches.
 - 4. Depth: 1-3/4 inches.
 - 5. Exposed Finish: Manufacturer's standard PVDF 3-coat color finish; color selected by the Architect from the manufacturer's standard colors.
 - 6. Bottom Side Finish: Manufacturer's standard pretreatment and white or light-colored acrylic or polyester backer finish consisting of both prime and wash coats for a total DFT of at least 0.5-mil.
 - 7. Panel Texture: Smooth.
 - 8. Protection: Apply strippable film to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. Remove strippable film just before installation.
- E. Metallic Finishes: Panels, components, and accessories having a metallic finish must be finished such that the metallic finish directionality (grain) of all components runs in the same direction when installed. Color variation caused by failure to comply with this requirement is non-conforming work.

2.4 ACCESSORIES

- A. Flashing, Trim, and Closures: Fabricated from same material as panels.
 - 1. Provide flashing, trim, and closures required to seal against weather and to match finished appearance, including bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers.
 - 2. Flashing, trim, and closure finish must match adjacent panel finish.
- B. Gaskets and Seals used in Panel Assembly: Supplied, required, recommended, or accepted by the manufacturer to conform to specified performance criteria; color selected by the Architect from manufacturer's standard colors.
- C. Edge Members and Perimeter Extrusions: Extruded aluminum at least 0.063-inch thick, with integral weather-stripping and finish matching adjacent panels.
- D. Clips and Fasteners: Concealed, non-corrosive, non-deteriorating clips and fasteners of quantity and type required, recommended, or accepted by manufacturer and that are that are compatible with roof panel faces.
- E. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
 - 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.

2. Reinforce framing members as required to receive fastener threads.
 3. Exposed fasteners are prohibited on faces exposed to view. Provide concealed fasteners and expansion provisions.
- F. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 FABRICATION

- A. Fabricate flashing and trim in conformance with SMACNA publication "*Architectural Sheet Metal Manual*" requirements for design, dimensions, metal, and other characteristics.
1. Form exposed sheet metal accessories without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Fabricate cleats and attachment devices from the same material as the accessory being anchored, or from compatible, noncorrosive metal required or recommended by metal roof panel manufacturer.
 3. Exposed fasteners are prohibited from faces of accessories exposed to view.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 2. Verify items penetrating roof panels are installed.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install roof panels using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed roof panels must be warrantable. Do not install, correct, or replace roof panels in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall.
2. Install panels perpendicular to girts and subgirts unless otherwise indicated. Securely fasten panels and other components in place with provisions for thermal and structural movement. Use concealed fasteners and anchorages where possible. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces and to make a weathertight connection.
3. Install roof panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels. Leave joints uniform-width with open reveals.
4. Form closely-fitted joints with exposed connections accurately located and secured.
5. Provide uniform-width perimeter reveals and opening sealants and joint fillers as indicated.
6. Flash and seal panels with weather closures at perimeter of openings. Install flashing and trim as roof panel work proceeds.
7. Do not apply sealants to joints unless otherwise indicated on Drawings.
8. Where weathertight panel joints are required, install concealed gaskets, flashings, joint fillers, and insulation as panel installation progresses. Comply with the requirements of Section 07 92 00 for installing sealants during panel installation.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach roof panels to supporting construction.

D. Installation Tolerances: Install roof panels within the following tolerance variations.

1. Squareness: Not more than 1/8-inch difference in diagonal measurements.
2. Maximum Offset between Components at Joints: 1/16-inch except that offset are not allowed at welded joints.
3. Maximum Misalignment of Adjacent Members: 1/16-inch.
4. Maximum Bow: 1/8-inch in 48 inches.

5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: After installation, correction, and repair are complete, remove strippable film or other temporary protection. Promptly remove from exposed metal surfaces anything that might interfere with uniform oxidation or weathering. Clean all visible surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed roof panels in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything adjacent to or against installed roof panels unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed roof panels as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 07 46 23 – WOOD SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood board siding.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the siding supplier, unless otherwise indicated.
 - 2. Failure: Includes noise or vibration caused by movement and material deterioration beyond normal.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate building superstructure tolerances with siding erection tolerances.
- B. Preinstallation Meeting:
 - 1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 - 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 - 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed siding. Resolve each condition.
 - 4. Finalize construction schedule.
 - 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data:
 - a. For manufactured items, submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing siding layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
 3. Samples: Submit at least 12-inch long representative samples of each siding type, color, finish, and variety. Include fasteners and exposed accessories.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished siding.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Siding must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing siding for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing siding for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading siding installers.

C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate siding into the mockup as part of the work of this specification section.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.

1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective siding with undamaged new siding that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 WOOD BOARD SIDING

- A. Siding: Indicated in the Schedule at the end of this specification section.

2.3 ACCESSORIES

- A. Cut Edge Sealer: Provide as supplied, recommended, approved, or accepted by the manufacturer for field-cut edges.
- B. Attachment Clips: "Viking Clips" manufactured by Specialty Lumber Solutions, or equal.
- C. Fasteners: Field finished fasteners, custom color matching siding.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.4 FINISHES

- A. Description: Penetrating semi-transparent color stain.
- B. Products: Indicated on the Drawings or selected by the Architect, or equal.
- C. Requisite Properties:
 1. Color: Selected by the Architect.
 2. Coats: Match Architect's design reference (target) sample. Provide (8) sample stained wood variations based on a control sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect

the quality of installation or the durability, appearance, or performance of installed and adjacent items.

2. Verify items penetrating siding are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install siding using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
4. Completed work must match approved samples and mockups, as accepted by the Architect.
5. Installed siding must be warrantable. Do not install, correct, or replace siding in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach siding to supporting construction.

C. Installation Tolerances: Install siding within the following tolerance variations.

1. Squareness: Not more than 1/8-inch difference in diagonal measurements.
2. Maximum Offset between Components at Joints: 1/16-inch except that offset are not allowed at welded joints.
3. Maximum Misalignment of Adjacent Members: 1/16-inch.
4. Maximum Bow: 1/8-inch in 48 inches.
5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: After installation, correction, and repair are complete, remove strippable film or other temporary protection. Promptly remove from exposed metal surfaces anything that might interfere with uniform oxidation or weathering. Clean all visible surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed siding in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed siding unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed siding as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

3.6 SCHEDULE

- A. WD-1: Douglas Fir Siding, Figure 4 quality, inside spaced stain/sealer.

- B. WD-2: Douglas Fir Siding, Figure 4 quality, Tongue and Groove exterior and stain/sealer.
- C. WD-3: "Redwood Siding Lost Coast Weathered" with clear sealer manufactured by Terramai, or equal. Sealed both sides.

END OF SECTION

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SECTION 07 54 23 – TPO ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. TPO membrane roofing.
2. Roofing insulation and cover board.
3. Installation materials.
4. Site tests and inspections.
5. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the roofing manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Verify chemical and adhesive compatibility of selected roofing with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.

B. Solar Energy Performance Requirements:

1. Minimum Solar Reflectance Index (SRI) Value: At least SRI 0.75 for low-slope roofs (less than 2:12 slope) and 0.16 for steep slope roofs (greater than or equal to 2:12 slope), when measured in compliance with ASTM E 1918.
2. Minimum Aged Reflectance Value: At least 0.63 for low-slope roofs (less than 2:12 slope) and 0.20 for steep slope roofs (greater than or equal to 2:12 slope), when maintained under normal conditions and measured in conformance with ASTM E 1918.
3. Minimum Emittance Value: At least 0.75, when measured in conformance with ASTM C 1371.

C. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.

2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, or performance of installed roofing. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

D. Sequencing:

1. Install roofing only after concrete is cured to a condition of equilibrium; is sufficiently dry to bond with roofing adhesives; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
2. Substrate repairs must be completed after surface preparation.
3. Install roofing only after penetrating items are installed.

E. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
2. Primer Installation: Roofing must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
3. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling traffic for at least 72 hours.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
2. Shop Drawings:

- a. Submit project-specific dimensioned plans drawn to scale showing roofing installation. Show locations and extents of all items and accessories. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing substrate joints and cracks, flashings, coating penetrations, transitions, terminations, and other conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
 3. Samples: Submit at least an 8- by 10-inch representative roofing sample for each specified variety, with a lapped seam in the center of each sample.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished roofing.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
 3. Manufacturer's Representative Reports:
 - a. Before beginning work, request and submit reports confirming substrates are properly prepared in conformance with manufacturer's instructions and other requirements and recommendations; are acceptable and satisfactory to receive the work of this specification section; and conform to all requirements necessary to issue specified and other warranties.
 - b. During the work, request and submit reports documenting actions taken by the manufacturer's representative to verify conformance with manufacturer's instructions and other requirements and recommendations.
 - c. Upon completion, request and submit reports confirming installed roofing conforms to all requirements necessary to issue specified and other warranties.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 1. Roofing must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).

- a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Regulatory Requirements:
1. Fire Resistance Rating: Roof coverings must conform to UL 790 fire resistance requirements for Class A rating. (effective against severe fire test exposures)
- C. Qualifications:
1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing roofing installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
 2. Installer: Company or individuals must have at least 5 years' experience installing roofing for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing roofing for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading roofing installers.
 4. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in size, material, design, and complexity.
- D. Field Samples: Include *in-situ* mockups as part of the work of this specification section.
1. Install at least one 100-square-foot field sample of each roofing membrane installation to verify selections made under sample submittal and to set quality standards for installation. Demonstrate surface preparation, crack repair, and joint, and corner preparation.
 2. Perform sheet moisture test in conformance with ASTM 4263.
 3. Test roofing membrane adhesion to verify surface preparation.
 4. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
 5. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of roofing is made from field samples.
 6. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
 7. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
 - 1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 - 4. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer
 - 5. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
 - 6. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 - 1. Avoid damage to packaging and containers, and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective roofing materials with undamaged new roofing materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install roofing only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.

1. Do not install roofing during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
 3. Apply only as much roofing as can be made weathertight each day, including all flashing and detail work. Apply uninterrupted waterstops at the end of each day's work, and completely remove them before proceeding with the next day's work.
- B. Existing Conditions: Surfaces receiving roofing must be dry. Install roofing only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
- C. Other Conditions: Do not apply roofing where dust is generated, or liquids are sprayed.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 20 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
1. Carlisle SynTec.
 2. Firestone Building Products Co., LLC.
 3. Johns Manville.

2.2 ROOFING MEMBRANE

- A. Description: Feltback reinforced TPO roofing membrane conforming to ASTM D 6878.
1. Unreinforced membranes are prohibited.
 2. Private label and third-party-manufactured membranes are prohibited.
- B. Products: "Sure-Weld FleeceBACK" manufactured by Carlisle SynTec, or equal.
- C. Requisite Properties:
1. Nominal Thickness: 60 mils, when measured in conformance with ASTM D 638.

2. Color: White.
3. Backing: Factory-applied felt backing (fleece backed).
4. Reinforcing Scrim: Polyester.

D. Performance Requirements:

1. Minimum Breaking Strength: At least 250 pounds force, when tested in conformance with ASTM D 751.
2. Minimum Elongation: At least 15 percent, when tested in conformance with ASTM D 751.
3. Minimum Seam Strength: At least 25 pounds-force, when tested in conformance with ASTM D 1876.
4. Minimum Tearing Strength: At least 55 pounds-force, when tested in conformance with ASTM D 751.
5. Maximum Water Absorption: Not more than 3.0 percent by weight, when tested in conformance with ASTM D 471.

2.3 ROOFING INSULATION AND COVER BOARD

A. Polyisocyanurate Insulation:

1. Description: Rigid, closed-cell board insulation consisting of a polyisocyanurate (polyiso) foam bonded to glass fiber reinforced organic mat facers on both sides.
2. Products: "Carlisle InsulBase Polyisocyanurate", or equal.
3. Requisite Properties:
 - a. Long Term Thermal Resistance: Assumed LTTR value of 5.6 per inch of thickness. If proposed insulation LTTR is less than 5.6 per inch, seek a written interpretation from the Architect to determine the necessary minimum thickness required to achieve specified R-values.
 - b. Minimum Compressive Strength: At least 20 pounds per square inch, when measured at either 5 percent deformation or yield, whichever occurs first.
 - c. Minimum Density: At least nominal 2.0 pounds per cubic foot when measure in conformance with ASTM 1622.
 - d. Minimum Tapered Insulation Thickness: At least 1-1/2 inches.
 - e. Tapered Insulation Main Slope: 1:48 (1/4-inch in 12 inches).

B. Cover Board:

1. Application: Used in horizontal applications as an overlayment for roof insulation and in vertical applications as a liner for the roof side of parapet walls.
2. Description: Commercial glass mat faced exterior sheathing conforming to ASTM C 1177 requirements for glass mat gypsum substrate.
3. Products:
 - a. Bareback Adhered Membrane and Vertical Applications: "DensDeck Prime" manufactured by GP Building Products, or equal.
 - b. Mechanically Fastened and Feltback Membrane Applications: "DensDeck" manufactured by GP Building Products, or equal.

4. Horizontal Applications: Provide 1/4-inch thick panels over insulation; provide at least 1/2-inch thick cover board directly over metal decks without insulation.
5. Vertical Applications: Provide 1/2-inch thick panels.
 - a. 1/4-inch roof cover board and gypsum sheathing are prohibited for vertical applications.
 - b. Roof cover boards installed in vertical applications (including as a liner for the roof side of parapet walls) must be installed by the same roofing installer that installs roof cover boards in horizontal applications (including as an overlayment for roof insulation).
 - c. Non-conformance with the above may negatively affect the specified warranty.
6. Wall Backings:
 - a. Light-duty wall backings specified in Section 05 40 00 must be installed to support reglets or termination bars in vertical applications, including on the roof side of parapet walls.
 - b. Wall backings must be installed over metal stud framing members before the roofing installer installs roof cover boards.

2.4 INSTALLATION MATERIALS

A. Fasteners and Stress Plates:

1. Insulation and Roof Cover Board: Provide the following unless otherwise supplied, required, recommended, approved, or accepted by the manufacturer.
 - a. Concrete Deck Fasteners: "CD-10 Fastener", or equal, carbon steel nail-in fasteners treated with a corrosion-resistant coating; used with "Insulation Fastening Plate" 3-inch metal stress plate to attach insulation and roof cover boards directly to concrete roof deck.
 - b. Metal and Wood Deck Fasteners: "HP Fastener", or equal, carbon steel threaded fasteners treated with corrosion-resistant coating; used with "Insulation Fastening Plate" 3-inch metal stress plate to attach insulation and roof cover boards directly to metal deck, or to 15/32-inch thick wood or 7/16-inch OSB decks.
2. Roof Membrane: Provide the following unless otherwise supplied, required, recommended, or accepted by the manufacturer.
 - a. Heavy-Gage Metal and Wood Deck Fasteners: "HP-X Fastener", or equal, carbon steel threaded fasteners treated with corrosion-resistant coating; used with "Piranah Plate" 2-3/8-inch diameter stress plate to attach membrane to 16- to 24-gage steel and 15/32-inch thick wood roof decks.
 - b. Thin-Gage Metal and Wood Deck Fasteners: "HP-Xtra Fastener", or equal, carbon steel threaded fasteners treated with corrosion-resistant coating; used with "Piranah Plate" 2-3/8-inch diameter stress plate to attach membrane to 22- to 24-gage steel and 1/2- to 5/8-inch thick wood roof decks.
3. Other Fasteners: Supplied, required, recommended, or accepted by the manufacturer.

- B. Tape: "SecurTAPE", or equal, long splice tape supplied, required, recommended, approved, or accepted by the manufacturer.
- C. Adhesive: The following, or otherwise supplied, required, recommended, or accepted by the manufacturer for the substrate indicated and the environmental conditions under which the roofing membrane is installed.
 - 1. Insulation and Roof Cover Board Adhesive: "FAST 100 LV", or equal, 2-component foamable polyurethane adhesive.
 - 2. Membrane and Flashing Adhesive: "Low VOC Bonding Adhesive 1168", or equal.
 - 3. Feltback Membrane Adhesive: "Flexible FAST Adhesive", or equal, foamable polyurethane adhesive.
- D. Sealant: "Universal Single-Ply Sealant" single-component polyether sealant, or other sealant supplied, required, recommended, or accepted by the manufacturer.
- E. Cut-Edge Sealant: Clear sealant used to seal cut edges of roofing membrane.
- F. Water Cut-Off Mastic: Mastic used to prevent moisture migration at drains, compression terminations and beneath conventional metal edging.
- G. Solvent Cleaner: "Weathered Membrane Cleaner" VOC-compliant cleaner or other cleaning agent supplied, required, recommended, or accepted by the manufacturer.

2.5 ACCESSORIES

- A. Detail Membrane: "Sure-Weld Detail Membrane", or equal, polyester reinforced TPO membrane.
 - 1. Thickness: 60 mils.
 - 2. Color: Match roofing membrane color.
- B. Flashing and Detail Membrane: "Sure-Weld Non-Reinforced TPO Flashing", or equal, non-reinforced TPO membrane.
 - 1. Thickness: 60 mils.
 - 2. Color: Match roofing membrane color.
 - 3. Primer: "TPO Low VOC Primer", or equal.
- C. Membrane-Clad Flashings: "Sure-Weld Coated Metal", or equal, membrane-clad flashings consisting of at least a 40-mil thick roofing membrane material laminated to one side of at least 0.0250-inch thick (USSG 24) galvanized steel.
- D. Flashing Accessories:
 - 1. Termination Bar: One inch wide by 98-mil thick extruded aluminum bar pre-punched at 6 inches on center and incorporates a sealant ledge to support sealant and provide increased stability for membrane terminations
 - 2. Prefabricated Flashings:

- a. Prefabricated Corners: "TPO Universal Corners", or equal, 60-mil prefabricated corners.
 - b. Single-Pipe Penetration Pipe Boots: "Pipe Flashings", or equal, 60-mil thick prefabricated membrane flashings with clamping rings for flashing single rooftop vent stacks and pipes.
 - c. Single Penetration: "Split Pipe Seals" or "TPO Square Tubing Wraps" or equal, 60-mil thick split and overlapped tab membrane flashings for flashing single obstructed rooftop conduits and pipes.
 - d. Multiple Penetrations: "Molded TPO Sealant Pocket", or equal, pre-fabricated, interlocking, 2-piece, injection molded, flexible pocket with a rigid polypropylene vertical wall and pre-formed deck flanges.
 - e. Pourable Sealer: "White One-Part Pourable Sealer", or equal, one-part, moisture curing, elastomeric polyether sealant used to fill molded TPO sealant pockets.
- E. Roof Walkways:
- 1. Description: Heavily textured and profiled rolled-out walkway protection mat
 - 2. Application: Used to protect roofing membrane from mechanical abuse.
 - 3. Product: "Sure-Weld Heat Weldable Walkway Rolls", or equal, rolled-out walkway protection mat.
 - 4. Requisite Properties:
 - a. Size: 34 inches wide by 180 mils thick.
 - b. Color: Provide gray walkways; dark-colored walkways are prohibited.
 - c. Layout: Conform to the lengths and locations indicated on shop drawings.
- F. Vapor Barrier and Temporary Roof: "VapAir Seal 725TR", or equal, 40-mil composite consisting of 35 mils of self-adhering rubberized asphalt laminated to a 5-mil woven polypropylene film.
- G. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: With installer and manufacturer's representative present, examine project conditions, including supporting and adjacent construction, and other conditions under which roofing is installed.

1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with roofing adhesion, appearance, or performance.
3. Verify items penetrating roofing are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Substrate Preparation:

1. Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
2. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of the installation, durability, or performance of furnished roofing.
3. Remove substrate ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface.

B. Termination and Penetration Preparation:

1. Prepare surfaces at terminations and penetrations through roofing and at expansion joints, drains, and sleeves in conformance with ASTM C 898 (horizontal applications) and the manufacturer's application instructions.
2. Prime substrates, unless otherwise required or recommended by the manufacturer.

C. Joint and Crack Preparation:

1. Differentiate between treatment of moving versus unmoving joints, and of cracks of different widths.
2. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 (horizontal applications), ASTM C 1471 (vertical applications) and the manufacturer's instructions. Before coating surfaces, remove dust and dirt from joints and cracks in conformance with ASTM D 4258.
 - a. Comply with ASTM C 1193 for joint-sealant installation.
 - b. Apply bond breaker between sealant and preparation strip.

3. Install sheet flashing and bond to the deck and wall substrates where indicated or required, and in conformance with the manufacturer's instructions. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate.

D. Substrate Acceptance:

1. Before starting installation, including priming, the manufacturer's representative must examine and certify that each prepared surface is
 - a. properly prepared in conformance with the specifications, with the manufacturer's application instructions, and in a manner that does not void specified warranties; and
 - b. satisfactory and ready to receive roofing.
2. Request and accommodate the manufacturer's representative's presence as required thereafter to review application progress, review completed work, and issue specified warranties.
3. Perform adhesion testing prior to start of work in each area.

3.3 INSTALLATION

A. General Requirements:

1. Install roofing using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install roofing under conditions that ensure membrane is free from blemishes and defects.
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed roofing must be warrantable. Do not install, correct, or replace roofing in a manner that results in any warranty or guarantee becoming void.

B. Roof Insulation Special Techniques:

1. Install tapered insulation in conformance with the slopes indicated.
2. Install insulation to thickness required to conform to specified performance requirements. Where overall insulation thickness is 2.7 inches or greater, install 2 or more layers with joints of each succeeding layer staggered at least 6 inches in every direction from the previous layer's joints.
3. Trim surface of insulation at roof drains where necessary so that completed surfaces are flush and do not restrict flow of water.
4. Install insulation with long panel joints in a continuous straight line; and with end joints staggered between rows, abutting edges, and ends between boards.
 - a. Fill gaps exceeding 1/4 inch with insulation.
 - b. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

C. Adhered Insulation Base Layer Special Techniques: Install each layer of insulation and adhere to the substrate.

1. Adhesive Ribbons: Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
 2. Full Spread Adhesive: Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
- D. Adhered Tapered Insulation Special Techniques:
1. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.
 2. Adhere insulation in conformance with the requirements of FMG Approvals' "RoofNav" for specified Windstorm Resistance Classification.
- E. Roof Cover Board Special Techniques:
1. Install cover boards over insulation with long joints in continuous straight lines; and with end joints staggered between rows.
 2. Offset cover board joints at least 6 inches in every direction from insulation board joints below.
 3. Loosely butt cover boards together.
- F. Adhered Cover Board Special Techniques:
1. Comply with manufacturer's installation instructions for coverage rates, set times, and other adhesive application guidelines and requirements.
 2. Adhere cover boards in conformance with the requirements of FMG Approvals' "RoofNav" for specified Windstorm Resistance Classification.
- G. Roof Membrane Special Techniques:
1. Apply roofing membrane over area indicated as receiving roofing in conformance with the manufacturer's application instructions.
 - a. Unroll roofing membrane and allow to relax before installing.
 - b. Install sheet according to ASTM D 5036.
 2. Begin roofing membrane application in the presence of the manufacturer's field representative.
 3. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
 4. Apply bonding adhesive to the substrate at rate required by the manufacturer. Do not apply bonding adhesive to splice area of the roofing membrane.
 5. Roll felt backed membrane into adhesive coat immediately and while still wet. To ensure proper contact, compress bonded half of sheet to substrate with a water-filled, foam covered, lawn roller. Fold un-adhered half of membrane sheet back onto itself, and repeat the bonding procedure to complete bonding of sheet. Lay smooth in order to minimize wrinkles.
 6. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
 7. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

8. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - a. Seam overlaps must be 3 inches wide when automatic machine welding and 4 inches wide when hand welding.
 - b. Overlaps must be with the flow of water where possible.
 - c. Welding equipment must be provided by or be approved by the membrane manufacturer. Mechanics intending to use the equipment shall have successfully completed a training course provided by a manufacturer's representative prior to welding.
 - d. Membrane surfaces to be welded must be clean and dry in accordance with the manufacturer's instructions. No adhesives must be present in the lap areas.
 - e. Test lap edges with probe to verify seam weld continuity.
 - f. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - g. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.
 - h. Grind edge of the membrane at corner laps as required to avoid pinholes at T-joints.
- H. Hand-Welding Special Techniques: Hand-welded seams must be completed in three stages. Hot-air welding equipment must be allowed to warm up for at least one minute prior to welding.
 1. The lap must be tack welded every 3 feet to hold the seam in place.
 2. The back edge of the seam must be welded with a narrow but continuous weld to prevent loss of hot air during the final welding.
 3. The nozzle must be inserted into the seam at a 45 degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to "flow," the hand roller must be positioned perpendicular to the nozzle and rolled lightly.
- I. Machine Welding Special Techniques: Machine welded seams are achieved by the use of various automatic welding equipment.
 1. When using this equipment, manufacturer's instructions must be followed and local codes for electric supply, grounding and over current protection observed.
 2. Automatic welding machines required 218 to 230 volts at 30 amps. Dedicated circuit house power or a dedicated portable generator is recommended.
- J. T-Joint (Three-Way Lap) Special Techniques:
 1. When welding a three-way overlap with membrane thicker than 1.5 mm, the top edge of the second membrane layer must be shaved down to create a smooth transition for the top membrane layer to conform to for positive welding.
 2. Chamfer the edge of the membrane using means and methods acceptable to manufacturer.
- K. Welded Seam Quality Control:

1. Completed welded seams must be checked by the installer after cooling for continuity using a rounded screwdriver or other suitable blunt object.
 2. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of black material from the edge of completed joints.
 3. On-site evaluation of welded seams must be made daily by the Contractor at locations as directed by the membrane manufacturer's representative.
 4. 2 inch wide cross-section samples of welded seams must be taken at least three times a day through completed seams.
 5. Correct welds display failure from shearing of the membrane prior to separation of the weld. Each test cut must be patched by the Contractor at no extra cost to the Owner.
 6. Welded seams must be left exposed until inspected and accepted by the membrane manufacturer.
- L. Deck Drain Special Techniques Prime flange at deck drains and spread sealant bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- M. Sealing Deck to Parapets: Seal the deck to the parapets and penetrations with urethane foam, suitable sealant, or self-adhesive vapor barrier in conformance with the manufacturer's installation instructions or other guidelines.

3.4 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.

2. Required Tests:

- a. Adhesion Testing: Before beginning work in each area, conduct adhesion tests with manufacturer's representative present at start of installation over each new substrate.
- b. Weld Testing: To ensure properly-welded seams, perform test welds in the morning before starting, after lunch, and anytime there is a change in weather. Before Final Completion, deliver to the Owner signed, dated, and time stamped test welds as a condition of project closeout.

B. Manufacturer Services: Installed work is subject to examination by the manufacturer's representative to determine conformance to manufacturer's instructions and other requirements and recommendations.

1. Note all defective items and non-conforming work identified by the manufacturer's representative.
2. Itemize into a punch list all noted items and record the manufacturer's requirements and recommendations for correcting each punch list item.
3. Promptly bring all punch list items into conformance with the manufacturer's requirements and recommendations until accepted in writing by the Architect.
4. Manufacturer's representative withholds issuing warranties until all punch list items are accepted by the Architect.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 CLOSEOUT ACTIVITIES

- A. Manufacturer's Services: Before examination and acceptance of installed roofing by the manufacturer's representative, convene a meeting at the project site with the manufacturer's representative to review completed work and issue warranties.
 - 1. Invite all parties to attend that were either present at the preinstallation meeting, or that should have been present but were not in attendance
 - 2. Notify invitees at least 10 business days before convening the meeting.

3.8 PROTECTION

- A. Protect installed roofing in place from deterioration and damage until covering.
- B. Do not permit foot or vehicular traffic onto unprotected roofing membranes.
- C. Do not store anything on, adjacent to, or against installed roofing unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed roofing as work surfaces.
- D. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Shop- or field-fabricated flashings used for roofing and flashing applications.
2. Delegated design of flashing assemblies.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 05 50 00 for dissimilar metal corrosion protection.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. BMT: Base Metal Thickness.msg
2. HDG: Hot-Dip Galvanized.
3. MSG: Manufacturer's Standard Gage for Sheet Steel.
4. USSG: United States Standard Gage for Sheet.
5. NRCA: National Roofing Contractors Association.
6. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

B. Definitions:

1. Fabricator: Means the decorative flashing fabricator, unless otherwise indicated.
2. Manufacturers' Standard Gage for Sheet Metal: Means the thickness steel sheet based on a weight of 41.82 pounds per square foot per inch of thickness.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate installation of roof perimeter flashings with installation of roof drainage system.
2. Coordinate installation of counterflashing with installation of base flashings.
3. Coordinate installation of roof-penetration flashings with installation of roofing and other items penetrating roof.

4. Coordinate the installation of equipment support flashings with the installation of roofing and equipment.
 5. Coordinate the installation of wall flashings with the installation of wall-opening components, including windows, doors, and louvers.
- B. Delegated Design Requirements:
1. Engineer, fabricate, assemble, and install flashings that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and results in structurally sound, non-corroding, and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
 2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.
- C. Performance Requirements:
1. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, *"Minimum Design Loads and Associated Criteria for Buildings and other Structures"*.
 2. Design Wind Rating:
 - a. Minimum Roof Field Area: 60 pounds per square foot.
 - b. Roof Perimeter Area: 90 pounds per square foot.
 - c. Roof Corner Area: 120 pounds per square foot.
 3. Design Negative Uplift Pressure: Coping system must conform to FMG requirements for at least a Class I-90 wind uplift rating.
 4. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
 5. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates.
- D. Preinstallation Meeting:
1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed flashings. Resolve each condition.
 4. Finalize construction schedule.
 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data:
 - a. For manufactured items, submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing flashing layout and types. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions. Cross-reference details to plans and elevations.
 - c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
 - d. Show backings, embedments, fasteners, brackets, clips, cleats, straps, mounting devices, and other attachments.
 - e. Label each attachment type; indicate manufacturer's product name for each manufactured item.
 - f. Indicate base material and finish, fastener material and finish, and material and finish of items being fastened or attached.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; analysis of supporting construction, including section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Quality Standard Requirements:

1. Design Standard: Comply with SMACNA publication "*Architectural Sheet Metal Manual*" requirements for design dimensions, geometry, metal thickness and other characteristics, and installation of flashings.
2. Installation Standard: Comply with NRCA publication "*Roofing and Waterproofing Manual*", Volume 2, "*Architectural Sheet Metal and Metal Roofing*" requirements for the design and installation of sheet metal flashing and trim items installed as part of roofing applications.

B. Qualifications:

1. Fabricator: Company or individuals must have at least 10 years' experience fabricating flashings installed on at least 100 previous projects similar to this project in size, material, design, and complexity
2. Installer: Company or individuals must have at least 5 years' experience installing flashings for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing flashings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading flashing installers.
4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate flashing into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped. Furnish adequate dunnage and bracing during storage.
 - 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 - 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective flashings with undamaged new flashings that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the

LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MATERIALS

- A. Hot-Dip Galvanized and Galvannealed Steel Sheet: ASTM A 653, CS Type B (commercial steel), with equal coating weight on each surface, coating weight designation (mass designation) indicated below on both surfaces.
 1. Natural Finish (Galvanized): Provide material with at least a G90 coating weight, regular spangle, chemically treated (desired for humid-storage stain resistance; can still be painted; recommended for sheet that will be used unpainted), and oiled (intended as a corrosion inhibitor; sheet must be thoroughly cleaned to remove the oil prior to painting).
 2. Shop-Painted Finish (Galvanized): Provide material with at least a G90 coating weight, minimized spangle, chemically treated (desired for humid-storage stain resistance; can still be painted; recommended for sheet that will be used unpainted), and oiled (for enhanced formability; sheet must be thoroughly cleaned to remove the oil prior to painting).
 3. Field-Painted Finish (Galvannealed): Provide material with at least an A60 coating weight, not chemically treated, not oiled, and mill phosphatized (paint-grip finish; provides enhanced lubricating characteristics).
- B. Stainless Steel Sheet:
 1. Exposed Locations: ASTM A 666 (annealed and tempered), Type 304L (for welded applications) or Type 304 (for all other applications), annealed, No. 2 (half hard) temper (hardness between Rockwell B-65 and B-70; can be bent 90 degrees across the direction of rolling around a radius equal to its thickness), passivated in conformance with ASTM A 967.
 - a. Natural Finish: Furnish materials having a No. 2B (bright) finish.
 - b. Painted Finish: Furnish materials having a No. 2D (matte) finish.
 2. Concealed Locations: ASTM A 240 (annealed) Type 304L (for welded applications) or Type 304 (for all other applications), annealed, No. 2 (half hard) temper (hardness between Rockwell B-65 and B-70; can be bent 90 degrees across the direction of rolling around a radius equal to its thickness), passivated in conformance with ASTM A 967.
 3. Natural Finish: Furnish materials having a No. 4 (bright) finish.
- C. Aluminum Sheet: ASTM B 209, 5005-H32 (for anodic finishing) and 3003-H14 (for painted or unfinished sheet).
- D. Pre-Painted Coated Coil and Sheet: ASTM A 755.
 1. Sheet: Aluminum sheet.

2. Top Side Finish: 70-percent by weight liquid polyvinylidene fluoride (PVDF) coating system conforming to AAMA 2605 and consisting of a prime coat applied to a DFT of at least 0.2-mil and either a solid color coat applied to a DFT of at least 0.75-mil; or a metallic color coat applied to a DFT of at least 0.75-mil and a clear topcoat applied to a DFT of at least 0.50-mil, as indicated on the Drawings or selected by the Architect.
3. Reverse Side Finish: 0.25-mil DFT acrylic bottom side primer and polyester wash coat (backer coat).
4. Painted Metallic Finishes: Panels, components, and accessories having a painted metallic finish must be finished such that the metallic finish directionality (grain) of all components runs in the same direction when installed. Color variation caused by failure to comply with this requirement is rejected as non-conforming work.

2.3 ROOFING AND ROOF EDGE FLASHINGS AND TRIM

A. Description:

1. Copings: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
2. Gravel Stops: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
3. Scuppers and Conductor Heads: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
4. Gutters: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
5. Downspouts: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.

B. Requisite Properties:

1. Profiles, Edge Styles, and Attachments: Indicated on the Drawings.
2. Joint Style: J2. (butt and backup plate)
3. Fabrication: Provide standard profiles from the SMACNA quality standard publication, Chapter 1.
 - a. Fabricate in sections between 8-and 10-feet long,
 - b. Fabricate backup plates from the same material and thickness as copings.
 - c. Miter corners, seal, mechanically fasten, and solder or weld watertight.
 - d. All corners and transitions must be shop or factory fabricated. Corner pieces shall extend minimum 12 inches beyond corner in both directions.
 - e. Only linear transitions may be field fabricated.
 - f. Finish: Field-applied duplex coating.

2.4 OTHER SHEET METAL FLASHINGS AND TRIM

A. Description:

1. Interlocking Counterflashing: Provide same material and thickness as reglets.

2. Through-Wall Flashings: Fabricate from at least 0.0250-inch thick (USSG 24) stainless steel sheet.
3. Opening Flashings in Framed Construction: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
4. Equipment Support Flashings: Fabricate from at least 0.0299-inch BMT (MSG 22) hot-dip galvanized and galvanized steel sheet.
5. Overhead-Piping Drip Pans: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
6. Elevator Hoistway Guards: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet.
7. Backpans: Fabricate from at least 0.0359-inch BMT (MSG 20) hot-dip galvanized and galvanized steel sheet, with equal coating weight on each surface, coating designation G90, not chemically treated, not oiled. Stiffen back pans as necessary to prevent "oil canning" or excessive deflection under load.
8. Flashings and Trim in Contact with Aluminum Components: Fabricate from at least 0.032-inch aluminum sheet.
9. Flashings and Trim in Contact with Concrete, Gravel, or Soil and Elsewhere Indicated: Fabricate from at least 26-ga. stainless steel Type 316 sheet.
10. Other Flashings and Trim: Unless otherwise noted, fabricate from at least 0.0299-inch BMT (MSG 22) hot-dip galvanized and galvanized steel sheet; or from at least 0.0250-inch (USSG 24) Type 316 stainless steel sheet.

2.5 ACCESSORIES

- A. Splash Pans: Standard precast concrete units cast from at least 4,000 pounds per square inch concrete. Precast units must have rounded corners and smooth and dense surfaces free of honeycombs.
- B. Soldering Materials:
 1. HDG Sheet Metal Solder and Flux: 50-percent tin solder conforming to ASTM B 32 Grade Sn50 and used with a non-corrosive flux.
 2. Stainless Steel Sheet Metal Solder and Flux: 60-percent tin solder conforming to ASTM B 32 Grade Sn60 and used with an acid flux.
- C. Fasteners: Provide fasteners and accessory materials suitable to the type of use and conditions of installation and service indicated; and as required for producing secure attachment to supporting construction without staining or deterioration of either the base materials or fastened materials; or deterioration of the fastener itself when in contact with base materials or fastened materials.
 1. Pop rivet attachment is prohibited.
 2. Provide fasteners are made of the same material as the fastened material or have a suitable barrier protection coating.
 - a. Apply corrosion-inhibiting material (e.g., pastes, washers, compounds, etc.) under the heads of screws or bolts inserted into dissimilar metal, even if they are already treated or have a protective coating.

- b. Washers, gaskets, and sleeves must be made of plastic or closed-cell polychloroprene (Neoprene).
 3. Verify fasteners and accessories that are galvanically compatible with fastened materials under conditions of installation and service, as demonstrated by the fastener manufacturer based on testing and field experience. Do not use fasteners that are corrosive or otherwise incompatible with fastened materials.
 4. Where fasteners are subject to loosening or turning out due to thermal and structural movements, wind loads, vibration, and other causes, provide self-locking devices that either maintain tension in the fastener assembly or remain locked even if tension in the assembly is lost. (e.g. washers, locknuts, and similar items)
 5. Exposed fasteners are prohibited on faces exposed to view. Provide concealed fasteners and expansion provisions. Where unavoidable, provide flat head cap screws (type FHCS) with drive slots filled and finished flush and smooth with adjacent surfaces.
- D. Underlayment:
 1. Description: Self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/non-asphaltic butyl adhesive flashing membrane, with release liner on the adhesive side. Asphaltic adhesive flashing membranes are prohibited.
 2. Product: "Grace Ultra" manufactured by GCP Applied Technologies, or equal.
 3. Requisite Properties:
 - a. Minimum Thickness: At least 30 mils.
 - b. Minimum Roll Width: 36 inches.
 - c. Maximum UV Exposure Limit: Not more than 100 days.
 - d. Maximum High Temperature Application: Up to 300 deg F.
- E. Sealant:
 1. Exposed Sealant: "756 SMS" neutral-curing silicone sealant manufactured by Dow Corning Corp., or equal conforming to ASTM C 920.
 2. Concealed Sealant: Single-component, solvent-release plasticized polyisobutylene (butyl rubber) conforming to ASTM C 1311; black color.
 3. Sheet Metal Lap Sealant: "Sikaflex 15LM" low-modulus urethane sealant manufactured by Sika Corp., or equal.
 4. Color: Selected by the Architect from the manufacturer's standard colors.
- F. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2-inch wide and 1/8-inch thick.
- G. Bituminous Coating: Cold-applied asphalt emulsion conforming to ASTM D 1187.
- H. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 FABRICATION

A. Shop Fabrication:

1. Before beginning fabrication, apply strippable film or other temporary protection normally furnished or necessary to protect metal from deterioration and damage during fabrication.
2. Fabricate items in largest sections practicable to minimize field jointing.
3. Fabricate flashing in thickness or weight needed to conform to the specified performance requirements, but not less than indicated for each application and metal.
4. Fabricate exposed work precise, straight, and true to line, size, and shape; plumb, level, and square within allowable tolerances; and with accurate angles and surfaces, and crisp straight edges.
5. Fabricate flashing without excessive oil canning, buckling, and tool marks; precise, straight, and true to line, size, shape, and levels indicated; with accurate angles and straight edges; and with exposed edges folded back to form hems.
6. Fabricate exposed connections with flush hairline joints, and square and true edges and corners.
7. Inside and outside corners, and changes in direction, must be fabricated watertight assemblies with mechanically-fastened and continuously welded or soldered joints.
8. Form non-expansion, but movable, joints in metal to accommodate sealant. Where lapped expansion provisions cannot be used, form expansion joints with at least one-inch deep intermeshing hooked flange; fill with butyl sealant concealed within joints.
 - a. Exposed fasteners are prohibited on faces exposed to view.
 - b. Provide concealed fasteners and expansion provisions elsewhere.
9. Fabricate cleats and attachment devices from the same material as the item being anchored, of sizes as recommended by the SMACNA quality standard publication for the application, but not less than thickness of metal being secured
10. Do not use graphite pencils to mark metal surfaces.

B. Fabrication Tolerances: Fabricated items must conform to the following; specified tolerances are non-cumulative.

1. Maximum Offset between Components at Joints: 1/8-inch except that at welded joints, offset are not allowed.
2. Maximum Deviation from Slope and Location Lines: 1/4-inch in 20 feet.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Oversight:
- Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.

- B. Verification: Verify that in-place construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the fabricator's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Scribe and cope items as necessary for an accurate fit. Perform required cutting, drilling, and fitting for flashing installation.
 - 2. Set flashings true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
 - 3. Shim as required with concealed shims.
 - 4. Install exposed flashings without excessive oil canning, buckling, and tool marks. Do not use graphite pencils to mark metal surfaces.
 - 5. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 - 6. Fit exposed connections accurately to form flush hairline joints. Trim to fit substrates and to result in watertight performance. Torch cutting is prohibited.
 - 7. Set sheet metal in bed of urethane sealant over concrete surfaces or coat with bituminous coating where compatible with overlying materials to prevent galvanic corrosion.
 - 8. Install sealant tape where indicated.
- B. Expansion Provisions: Provide provisions for thermal expansion.
 - 1. Space movement joints not more than 10 feet on center. Joints may not be located within 24 inches of corners or intersections.
 - 2. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints with intermeshing hooked flanges at least one inch deep, and fill with sealant concealed within the joints.
 - 3. At exposed sheet metal fabrications, provide 8 in. wide splice plates. Set sheet metal laps in low-modulus urethane sealant. At sheet metal backing, provide 8-inch wide splice plates or at least 4-inch laps set in bed of low-modulus urethane sealant between pieces of sheet metal. Do not apply sealant to surface of joints.
- C. Seal joints where indicated on the Drawings and as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members at least one inch into the sealant. Form joints to completely conceal sealant.

2. When ambient temperature at the time of installation is between 40 and 70 deg. F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg. F.
 3. Prepare joints and apply sealants in conformance with Section 07 92 00.
- D. Soldered Joints:
1. Soldered joints must also be mechanically fastened
 2. Clean surfaces to be soldered.
 3. Pre-tin sheet edges to at least 1-1/2 inches from the edge; reduce pre-tinning area where the pre-tinned surface might show in the completed work.
 4. Promptly remove acid flux residue from metal after tinning and soldering. Clean and neutralize in conformance with the solder manufacturer's installation instructions.
 5. Do not use torches for soldering.
 6. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
- E. Special Techniques:
1. Roof Drainage System: Install sheet metal roof drainage components as indicated to produce a complete roof drainage system conforming to the referenced standard.
 2. Roof Flashing: Install sheet metal flashing and trim in conformance with specified performance requirements, the SMACNA quality standard publication requirements. Provide concealed fasteners where possible, set units true to line, and level. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
 3. Roof Edge Flashing: Anchor to resist uplift and outward forces in conformance with the SMACNA quality standard publication and recommendations. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
 4. Copings: Anchor to resist uplift and outward forces in conformance with the SMACNA quality standard publication requirements and recommendations and roofing requirements.
 - a. Interlock exterior bottom edge of coping with continuous cleat anchored to the supporting substrate at not more than 24-inches on center.
 - b. Anchor the interior leg of copings with washers and screw fasteners through slotted holes at not more than 24 inches on center.
 5. Pipe and Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
 6. Counterflashing: Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant.
 7. Roof-Penetration Flashing: Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof. All penetrations must receive umbrella flashings.

8. Wall Flashing: Install sheet metal wall flashing as indicated, and to intercept and exclude penetrating moisture in conformance with the referenced standard's recommendations.
9. Opening Flashing in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend beyond wall openings as indicated on the shop drawings.
10. Miscellaneous Flashing:
 - a. Equipment Support Flashing: Weld or seal flashing with elastomeric sealant to equipment support members.
 - b. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated. Pipe and install drain lines to plumbing waste or drainage system as indicated on the plumbing drawings.

F. Interface with Adjacent Items:

1. Provide materials, components, and accessories normally furnished or necessary to securely attach flashing to supporting construction.
2. Provide provisions for thermal and structural movement.
3. Space cleats not more than 12 inches apart. Anchor each cleat with at least 2 fasteners. Bend tabs over fasteners.

G. Installation Tolerances: Shim and align flashing within an installed tolerance of 1/4-inch in 20 feet on slope and location lines indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: After installation, correction, and repair are complete, remove strippable film or other temporary protection. Promptly remove from exposed metal surfaces anything that might interfere with uniform oxidation or weathering.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.
- C. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed flashing in place from deterioration and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed flashings unless they are protected from damage. Do not use installed flashings as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 07 65 26 – SASM FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. SASM through-wall, opening, penetration, and transition flashings that are not integral to WRB or AB installation.
2. Roof and façade SASM underlayment.
3. Installation materials.
4. Surface preparation.
5. Site tests and inspections.
6. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
2. Section 06 16 43 for treatment of sheathing panel joints.
3. Section 07 25 13 for self-adhering sheet flashings, installation materials, and accessories integral to sheet WRB installation.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. WRB: Weather-Resistive Barrier.
2. VDR: Vapor Diffusion Retarder.
3. AB: Air Barrier.
4. SASM: Self-Adhering Sheet Membrane.
5. UV: Ultraviolet Solar Radiation.

B. Definitions:

1. Manufacturer: Means the flashing manufacturer, unless otherwise indicated.
2. Roof: Means the top cover of a building having a slope of 60 degrees or less from the zero-degree horizontal plane.
3. Non-Roof: Means the top cover of a building having slope more than 60 degrees from the zero-degree horizontal plane.
4. Wall: Means one of the sides of a room or building connecting a floor and ceiling or foundation and roof, and having slope less than 30 degrees from the 90-degree vertical plane.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Performance Requirements: SASM flashing membranes installed around the perimeter of exterior opening assemblies and other penetrations must conform to Level 3 (elevated temperature exposure) requirements of American Architectural Manufacturers Association publication AAMA 711, *Voluntary Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products*.
- B. Coordination: Verify chemical and adhesive compatibility of selected flashings with installed waterproofing, WRBs, ABs, VDRs, roofing, sealants, and other items with which the flashings are in direct contact, based on current product formulations.
- C. Preinstallation Meeting:
 - 1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
 - 2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
 - 3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, or performance of installed WRBs. Resolve each condition.
 - 4. Finalize construction schedule.
 - 5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- D. Sequencing:
 - 1. Install flashings only after penetrating items are installed.
 - 2. Install flashings only after openings are framed.
- E. Scheduling:
 - 1. Installations Requiring Primer: Flashings must be applied within 24 hours of primer installation. Schedule installation to limit exposure of primed surfaces to not more than 24 hours. Re-prime surfaces exposed for more than 24 hours in conformance with manufacturer's instructions for re-priming.
 - 2. UV Exposure: Schedule installation to keep flashing exposure to UV within the manufacturer's recommended limits.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets

(SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings:
 - a. Submit dimensioned drawings showing joints, seams, tie-ins, and dimensions, including terminations, penetrations, coves, interior and exterior corner conditions, openings, penetrations, and expansion and drift joints.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished flashings.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
 3. Manufacturer's Representative Reports:
 - a. Before beginning work, request and submit reports confirming substrates are properly prepared in conformance with manufacturer's instructions and other requirements and recommendations; are acceptable and satisfactory to receive the work of this specification section; and conform to all requirements necessary to issue specified and other warranties.
 - b. During the work, request and submit reports documenting actions taken by the manufacturer's representative to verify conformance with manufacturer's instructions and other requirements and recommendations.
 - c. Upon completion, request and submit reports confirming installed roofing conforms to all requirements necessary to issue specified and other warranties.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 1. Flashings must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.

2. Flashings must be obtained only from a manufacturer that sends a representative to the project site before beginning work to verify existing conditions; and during work to perform manufacturer's field services.
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing flashings installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Installer: Company or individuals must have at least 5 years' experience installing flashings for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing flashings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading flashing installers.
4. Manufacturer's Representative: Individuals must have at least 5 years' technical field experience performing manufacturer's services for at least 50 previous projects similar to this project in size, material, design, and complexity.

C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate flashings into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 2. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
 3. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)

4. Incline covered items to ensure maximum drainage of accumulated moisture.
 5. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install flashings only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
1. Do not install flashings during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
- B. Existing Conditions: Surfaces to which flashings are installed must be dry. Install flashings only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
- C. Other Conditions: Do not apply flashings where dust is generated, or liquids are sprayed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Carlisle Coatings and Waterproofing Inc.
 2. GCP Applied Technologies.
 3. Henry Co.

2.2 THROUGH-WALL SASM FLASHING

A. Standard Through-Wall Flashing:

1. Description: Self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/rubberized asphalt adhesive flashing membrane, with release liner on the adhesive side, conforming to AAMA 711 requirements for self-adhered flashing materials.
2. Applications: Through-wall flashing for cavity wall applications.
3. Products: "Perm-A-Barrier Wall Flashing" manufactured by GCP Applied Technologies, or equal.
4. Requisite Properties:
 - a. Minimum Thickness: At least 40 mils.
 - b. Minimum Roll Width: At least 12 inches.
 - c. Maximum UV Exposure Limit: Not more than 45 days.
 - d. Color: Green with repeated logo imprint.
5. Performance Requirements:
 - a. Maximum Water Vapor Transmission: Not more than 0.05-perm, when tested in conformance with ASTM E 96 method B.
 - b. Minimum Pull Adhesion to Concrete: At least 60 pounds per foot, when tested in conformance with ASTM D 903 modified.
 - c. Minimum Low Temperature Flexibility: Unaffected at minus 45 deg. F, when tested in conformance with ASTM D 1970.
 - d. Minimum Elongation: At least 200 percent, when tested in conformance with ASTM D 412 die C modified.

B. Aluminum-Faced Detail Membrane:

1. Description: Aluminum-faced self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/rubberized asphalt adhesive, with release liner on the adhesive side, conforming to AAMA 711 requirements for self-adhered flashing materials.
2. Applications: Detail membrane for air and vapor barrier applications.
3. Restrictions: May not be used when aluminum facing might contact cementitious materials (e.g., Portland cement plaster) or dissimilar metals.
4. Products: "Perm-A-Barrier Aluminum Flashing" manufactured by GCP Applied Technologies, or equal.
5. Requisite Properties:
 - a. Minimum Thickness: At least 40 mils.
 - b. Minimum Roll Width: At least 9 inches.
 - c. Maximum UV Exposure Limit: Not more than 270 days.
 - d. Color: Natural finish aluminum.
6. Performance Requirements:
 - a. Maximum Water Absorption: Not more than 0.1 percent, when tested in conformance with ASTM D 570.

- b. Minimum Puncture Resistance: At least 80 pounds, when tested in conformance with ASTM E 154.
- c. Minimum Elongation: At least 200 percent, when tested in conformance with ASTM D 412 die C modified.

2.3 OPENING AND PENETRATION SASM FLASHING

A. Standard SASM Flashing:

- 1. Description: Self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/rubberized asphalt adhesive flashing membrane, with release liner on the adhesive side, conforming to AAMA 711 requirements for self-adhered flashing materials.
- 2. Applications: Deck-to-wall intersections, inside and outside corners of sheathing, wall-to-wall tie-ins, foundation sill plates, sheathing panel seams, and other non-roof detail areas.
- 3. Restrictions: May not be used
 - a. in hot desert areas in the southwestern United States;
 - b. in contact with flexible PVC or vinyl windows; and
 - c. with certain metal windows having integral nail fins.
- 4. Products: "Vycor Plus" manufactured by GCP Applied Technologies, or equal.
- 5. Requisite Properties:
 - a. Minimum Thickness: At least 25 mils.
 - b. Minimum Roll Width: At least 9 inches.
 - c. Maximum UV Exposure Limit: Not more than 21 days.
 - d. Color: Black-gray.
- 6. Performance Requirements:
 - a. Maximum Water Vapor Transmission: Not more than 0.05-perm, when tested in conformance with ASTM E 96 method B.
 - b. Minimum Pull Adhesion to Plywood: At least 3 pounds per inch, when tested in conformance with ASTM D 903 modified.
 - c. Minimum Low Temperature Flexibility: Unaffected at minus 20 deg. F. , when tested in conformance with ASTM D 1970.
 - d. Minimum Elongation: At least 250 percent, when tested in conformance with ASTM D 412 die C modified.

B. Aluminum-Faced SASM Flashing:

- 1. Description: Aluminum surfaced self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/rubberized asphalt adhesive, with release liner on the adhesive side, conforming to AAMA 711 requirements for self-adhered flashing materials.
- 2. Applications: Deck-to-wall intersections, inside and outside corners of sheathing, wall-to-wall tie-ins, foundation sill plates, sheathing panel seams, and other non-roof detail areas.
- 3. Restrictions: May not be used

- a. in hot desert areas in the southwestern United States;
 - b. in contact with flexible PVC or vinyl windows;
 - c. with certain metal windows having integral nail fins; and
 - d. when aluminum facing may contact cementitious materials (e.g., Portland cement plaster) or dissimilar metals.
 4. Products: "Vycor Aluminum Flashing" manufactured by GCP Applied Technologies, or equal.
 5. Requisite Properties:
 - a. Minimum Thickness: At least 25 mils.
 - b. Minimum Roll Width: At least 6 inches.
 - c. Maximum UV Exposure Limit: Not more than 350 days.
 - d. Color: Natural finish aluminum.
- C. Butyl SASM Flashing:
1. Description: Self-adhering cross-laminated polypropylene sheet/non-asphaltic butyl adhesive flashing membrane, with release liner on the adhesive side, conforming to AAMA 711 Level 3 requirements for elevated exposure self-adhered flashing materials. Asphaltic adhesive flashing membranes are prohibited.
 2. Applications: Used for flashing around window and door headers, sills, jambs, thresholds, and nailing flanges; and under exterior plaster (stucco) trims.
 3. Products: "Vycor PRO" manufactured by GCP Applied Technologies, or equal.
 4. Requisite Properties:
 - a. Minimum Thickness: At least 14 mils.
 - b. Minimum Roll Width: At least 9 inches.
 - c. Maximum UV Exposure Limit: Not more than 100 days.
 - d. Color: White with green paint.

2.4 SASM UNDERLAYMENT

- A. High Temperature SASM Underlayment:
1. Description: Self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/butyl adhesive flashing membrane, with release liner on the adhesive side.
 2. Applications: Roof detail areas, including under equipment flashings, as ice dam protection, at roof valleys and rake edges, and around chimneys and skylights.
 3. Restrictions: May not be used
 - a. folded over roof edges, unless protected by a drip edge, gutter, or other flashing material;
 - b. on chamfered edges of wood planks;
 - c. installed directly over old roof coverings;
 - d. installed directly under roof coverings that are especially sensitive to corrosion, including zinc, without providing proper ventilation; and
 - e. installed under copper, Cor-Ten, or zinc metal roofing in high altitudes.

4. Products: "Grace Ice & Water Shield HT" manufactured by GCP Applied Technologies, or equal.
5. Requisite Properties:
 - a. Minimum Thickness: At least 40 mils.
 - b. Minimum Roll Width: 36 inches.
 - c. Maximum UV Exposure Limit: Not more than 100 days.
 - d. Maximum High Temperature Application: Up to 260 deg F.
 - e. Color: Gray-black.
6. Performance Requirements:
 - a. Minimum Membrane Tensile Strength: At least 31 pound feet per inch, when tested in conformance with ASTM D 412, Die C modified.
 - b. Minimum Membrane Elongation: At least 250 percent, when tested in conformance with ASTM D 412, Die C modified.
 - c. Minimum Low Temperature Flexibility: Unaffected to at least -20 deg. F, when tested in conformance with ASTM D 1970.
 - d. Minimum Adhesion to Plywood: At least 5.0 pounds per inch of width, when tested in conformance with ASTM D 903.
 - e. Maximum Permeance: Not more than 0.05 perms, when tested in conformance with ASTM E 96 method B

B. Butyl SASM Underlayment:

1. Description: Self-adhering cross-laminated high-density polyethylene (HDPE) composite sheet/non-asphaltic butyl adhesive flashing membrane, with release liner on the adhesive side. Asphaltic adhesive flashing membranes are prohibited.
2. Applications: Roof detail areas, including under equipment flashings, as ice dam protection, at roof valleys and rake edges, and around chimneys and skylights.
3. Restrictions: May not be used
 - a. in contact with polysulfides;
 - b. in contact with flexible PVC or vinyl windows; and
 - c. with high concentrations of resin (pitch) that may be found in some wood plank decks.
4. Products: "Grace Ultra" manufactured by GCP Applied Technologies, or equal.
5. Requisite Properties:
 - a. Minimum Thickness: At least 30 mils.
 - b. Minimum Roll Width: 36 inches.
 - c. Maximum UV Exposure Limit: Not more than 100 days.
 - d. Maximum High Temperature Application: Up to 300 deg F.
 - e. Color: Gray-black.
6. Performance Requirements:
 - a. Minimum Membrane Tensile Strength: At least 250 pounds per square inch, when tested in conformance with ASTM D 412, Die C modified.
 - b. Minimum Membrane Elongation: At least 250 percent, when tested in conformance with ASTM D 412, Die C modified.

- c. Minimum Low Temperature Flexibility: Unaffected to at least -2 deg. F , when tested in conformance with ASTM D 1970.
- d. Minimum Adhesion to Plywood: At least 3.0 pounds per inch of width, when tested in conformance with ASTM D 903.
- e. Maximum Permeance: Not more than 0.05-perm, when tested in conformance with ASTM E 96 method B

2.5 INSTALLATION MATERIALS

A. Liquid Flashing:

- 1. Description: Trowel grade, asphalt modified urethane.
- 2. Application: Used as repair material for defects on concrete surfaces; as fillet and reinforcement material at inside corners; as flashing material at outside corners and around drains, protrusions, curbs and parapets; and as sealing material at membrane terminations.
- 3. Product: "Bituthene Liquid Membrane" manufactured by GCP Applied Technologies, or equal.

B. Green Concrete Primer:

- 1. Description: Low-VOC solvent-based primer.
- 2. Applications: Used to prime green concrete cured less than 7 days; and to prime damp concrete, masonry, sheathing or wood surfaces to which SASMs are applied.
- 3. Product: "Bituthene Primer B2 LVC" manufactured by GCP Applied Technologies, or equal.

C. Sheathing Primer:

- 1. Description: Water-based primer.
- 2. Application: Used to prime fiber cement and GMF gypsum sheathing.
- 3. Product: "Perm-A-Barrier WB Primer" manufactured by GCP Applied Technologies, or equal.

2.6 ACCESSORIES

A. Sealant:

- 1. Description: Silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 25.
- 2. Product: "758" manufactured by Dow Corning Corp., or equal.
- 3. Color: White.

B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with flashing adhesion, appearance, or performance.
 - 3. Verify items penetrating flashings are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Substrate Preparation:
 - 1. Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 - 2. Remove substrate coatings and other substances that may negatively affect the quality of the installation, durability, or performance of furnished flashings.
 - 3. Remove substrate ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install flashings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Only install flashings under conditions that ensure they are free from blemishes and defects.

3. Completed work must match approved samples and mockups, as accepted by the Architect.
 4. Installed flashings must be warrantable. Do not install, correct, or replace flashings in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Accurately align flashing membranes and maintain uniform side and end laps at least 3 inches or as specifically depicted in the project details. Apply flashing membranes with side laps shingled in the direction of bulk water flow.
 2. Clean seam areas, overlap flashing membranes, and roll side and end laps in conformance with the flashing manufacturer's installation instructions to ensure a watertight seam installation.
 3. Press and form material tightly against the substrate.
 - a. Pressure is essential to eliminate wrinkles and bubbles.
 - b. Ensure complete and continuous adhesion by using a hard neoprene or stainless steel hand roller.
 - c. Apply sealant or liquid membrane at flashing membrane leading edges.
 4. Install flashing around windows in the following order.
 - a. Install in conformance with details indicated on Drawings.
 - b. Install in conformance with the flashing membrane manufacturer, and the door and window manufacturers' installation instructions.
 - c. Install in conformance with ASTM E 2112.
 5. Install flashing under copings over wall flashing, WRBs, and roof membranes.
 - a. Provide aluminum-faced flashing separation at incompatible materials.
 - b. Lap joints at least 3 inches.
 - c. Hand-roll seams for complete adherence to substrate.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach flashing to supporting construction.

3.4 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.

- e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
 2. Adhesion Testing: Before beginning work in each area, conduct adhesion tests with manufacturer's representative present at start of installation over each new substrate.
- B. Manufacturer Services: Installed work is subject to examination by the manufacturer's representative to determine conformance to manufacturer's instructions and other requirements and recommendations.
 1. Note all defective items and non-conforming work identified by the manufacturer's representative.
 2. Itemize into a punch list all noted items and record the manufacturer's requirements and recommendations for correcting each punch list item.
 3. Promptly bring all punch list items into conformance with the manufacturer's requirements and recommendations until accepted in writing by the Architect.
 4. Manufacturer's representative withholds issuing warranties until all punch list items are accepted by the Architect.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
 1. Repair punctures, tears, voids, and deficient lapped seams that do not conform to specified requirements. Slit and flatten fishmouths and blisters.
 2. Extend patches 6 inches beyond repaired areas in all directions. Seal edges with sealant or liquid membrane.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and

3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 PROTECTION

- A. Protect installed flashings in place from prolonged exposure to UV manufacturer's recommended limits, exposure to weather, becoming wet, contact with damp or wet surfaces, and other sources of deterioration, and damage until covering flashings. If exposed to UV for more than the recommended limit, then flashings must be removed and replaced in conformance with the manufacturer's instructions.
- B. Do not store anything on, adjacent to, or against installed flashings unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed flashings as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 07 72 33 – ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof hatch assemblies
2. Fire-rated roof hatch assemblies.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 05 51 34 for access ladders.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the roof hatch manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate building opening tolerances with roof hatch manufacturing and erection tolerances.
- B. Performance Requirements: Roof hatches must establish and maintain a continuous watertight seal without failure.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished roof hatches.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Roof hatches must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain roof hatches may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Qualifications:
 - 1. Installer: Company or individuals must have at least 5 years' experience installing roof hatches for at least 30 previous projects similar to this project in size, material, design, and complexity.

2. Supervisors: Individuals must have at least 7 years' experience installing roof hatches for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading roof hatch installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective roof hatches with undamaged new roof hatches that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements

B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.

1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

A. Manufacturers: Provide products manufactured by one of the following, or equal.

1. The Bilco Co.
2. JL Industries.
3. Nystrom, Inc.

2.3 ROOF HATCH ASSEMBLIES

A. Description: Thermally-broken roof hatch.

B. Products: "Type E-50TB" manufactured by The Bilco Co., or equal.

C. Requisite Properties:

1. Size: 36- by 36-inch square opening
 - a.
2. Material: At least 0.090-inch thick aluminum sheet.
3. Finish: Mill finish.

D. Components:

1. Curb: At least 12 inches high with integral cap flashing, fully welded corners, at least 4-1/2-inch mounting flange with pre-drilled holes for securing frame to roof deck.
2. Curb Insulation: 2-inch thick polyisocyanurate board insulation having an LTTR-value of at least R-11 (R-5.7 per inch of thickness).
3. Cover: Internally reinforced to accommodate, resist, distribute, or transfer at least 40 pounds per square foot live load with a maximum deflection of L/50; and 20 pounds per square foot uplift load. Cover must have at least a 4-inch beaded and fully-welded overlapping flange and 2-inch thick fully covered and protected polyisocyanurate cover insulation having a LTTR-value of at least R-11 (R-5.7 per inch of thickness).
4. Gasket: Extruded ethylene propylene diene monomer (EPDM) elastomeric gasket permanently adhered to cover.

5. Hinges: Heavy-duty pintle hinges with at least 3/8-inch Type 316 stainless steel hinge pins.
6. Latch: Slam latch with interior and exterior turn handles and padlock hasps.
7. Lift Assistance: Compression spring operators enclosed in telescoping tubes, and automatic hold-open arm with grip handle release.
8. Hardware: Type 316 stainless steel.

2.4 FIRE-RATED ROOF HATCH ASSEMBLIES

- A. Description: Thermally-broken roof hatch.
- B. Products: "Type SRHTB" manufactured by Surespan Ltd USA, or equal.
- C. Components:
 1. Curb: Nominal 12 inches high, manufactured from steel with integral cap flashing, fully welded corners, at least 4-1/2-inch mounting flange with pre-drilled holes for securing frame to roof deck.
 2. Curb Insulation: Nominal 2 inches of non-combustible mineral wool insulation Having an R-value of at least R-9.
 3. Cover: Stainless steel, internally reinforced to accommodate, resist, distribute, or transfer at least 40 pounds per square foot live load with a maximum deflection of L/50; and 20 pounds per square foot uplift load. Cover must have at least a 4-inch beaded and fully welded overlapping flange and nominal 2 inches of non-combustible mineral wool insulation Having an R-value of at least R-9.
 4. Gasket: Extruded ethylene propylene diene monomer (EPDM) elastomeric gasket permanently adhered to cover.
 5. Hinges: Heavy-duty pintle hinges with at least 3/8-inch Type 316 stainless steel hinge pins.
 6. Latch: Slam latch with interior and exterior turn handles and padlock hasps.
 7. Lift Assistance: Manufacturer's standard gas spring assisted opening. Lid must have a provision to lock in the open position with a safety hold open stay to prevent against accidental closure
 8. Hardware: Type 316 stainless steel.

2.5 ACCESSORIES

- A. Ladder Safety Post: "LadderUp" safety post manufactured by The Bilco Co., or equal.
- B. Fall Prevention: "Bil-Guard" fixed hatch railing system manufactured by The Bilco Co., or equal. Furnish model number recommended by the manufacturer as compatible with selected roof hatch.
- C. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install roof hatches using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 - 4. Installed roof hatches must be warrantable. Do not install, correct, or replace roof hatches in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach roof hatches to supporting construction.
- C. Installation Tolerances: Install roof hatches to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 ADJUSTING

- A. Verify smooth and quiet roof hatch and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 07 84 00 – FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Through-penetration firestop systems.
2. Fire-resistive joint systems (fire calks).
3. Perimeter fire-resistive joint systems (fire safing).
4. Surface preparation.
5. Installation materials.
6. Site tests and inspections.
7. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 81 33 for firestop putty pads.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. UL: Underwriter's Laboratories.

B. Definitions:

1. Manufacturer: Means the firestopping manufacturer, unless otherwise indicated.
2. Fire Partition Means construction designed and tested to resist the passage of fire for a prescribed time, specifically at fire barriers, fire walls, shafts, exit enclosures, smoke barriers, corridor construction and other construction assemblies.
3. L-Rating: Means the amount of air or cold smoke that can leak through a penetration, when tested in conformance with UL 1479.
4. F-Rating: Means the time a penetration firestop system prevents the passage of fire through a penetration, when tested in conformance with ASTM E 814 or UL 1479.
5. T-Rating: Means the time a firestop system, including the penetrating item, limits the maximum temperature rise to 325 deg. F above its initial temperature through the penetration on the non-fire side, when tested in conformance with ASTM E 814 or UL 1479.
6. Assembly Rating: Means the combination of T- and F-ratings in an assembly, with F equaling T, when tested in conformance with ASTM E 1966 or UL 2079.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Assisted by the selected manufacturer, choose firestopping components, products, and materials that correspond to selected firestopping systems shown by reference designations to
 - a. Underwriters Laboratories, as listed in UL publication, "*Fire Resistance Directory*".
 - b. Intertek's ETL SEMKO Division, as listed in its Omega Point Laboratories publication, "*Directory of Listed Building Products, Materials, & Assemblies*".
2. Where modifications to tested assemblies are necessary to suit project conditions or address applications for which there are no tested systems, obtain engineering judgments from the firestopping manufacturer derived from similar qualified tested system designs and other testing.
 - a. Submit engineering judgments for review and approval and obtain written acceptance of modifications prior to submitting shop drawings to the Architect.
 - b. Engineering judgment documents must conform to International Firestop Council for Evaluating Firestop Systems Engineering Judgments requirements.
3. Coordinate openings and penetrating items to ensure installed firestopping conforms to specified requirements and the selected firestop system testing laboratory designation.
 - a. Coordinate sizing of sleeves, openings, core-drilled holes, and cut openings to accommodate firestop systems in conformance with the manufacturer's requirements and recommendations.
 - b. Provide exposed firestopping material colors selected by the Architect from the standard color range currently available from the manufacturer. Custom colors are prohibited.

B. Acoustical Requirements: Provide non-hardening resilient firestop material at penetrations, sleeves, and passthroughs in acoustic construction assemblies.

C. Sequencing: After firestopping installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Submit project-specific key plans showing firestopping installations.
3. Firestopping Schedule: Submit firestopping schedule indicating firestopping types, laboratory tested assembly numbers, protected elements including sizes, materials,

and minimum hourly fire-resistance rating for each fireproofed item. Cross-reference firestopping schedule to key plans.

- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished firestopping.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Firestopping must be obtained through one source from the same manufacturer (to ensure compatibility and a uniform appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing firestopping for at least 30 previous projects similar to this project in size, material, design, and complexity. Installers and supervisors must be
 - a. authorized, certified, licensed, or otherwise qualified by the manufacturer for at least the past 5 consecutive years as having the necessary experience, personnel, and training to install or apply the manufacturer's products, including all related components and accessories; and
 - b. approved by FM Approvals in conformance with FMG publication Class Number 4991, "*Approval Standard for Approval of Firestop Contractors*" or qualified by UL in conformance with its "*Qualified Firestop Contractor Programs*".
 - c. Only personnel trained and certified by the manufacturer in the proper installation or application techniques may supervise or perform any of the work of this specification section.
 2. Supervisors: Individuals must have at least 7 years' experience installing firestopping for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading firestopping installers.
- C. Field Samples: Include *in-situ* mockups as part of the work of this specification section.
1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
 2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of firestopping is made from field samples.
 3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
 4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential

accumulation of moisture beneath tarpaulin during certain environmental conditions)

3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective firestopping materials with undamaged new firestopping materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install firestopping only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
1. Do not install firestopping during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
 3. Do not apply firestopping when
 - a. ambient temperature is below 45 deg. F or more than 90 deg. F during application, and for at least 8 hours after;
 - b. surface temperatures are less than 40 deg. F or greater than 120 deg. F; and
 - c. surface temperatures are 5 deg. F or less above the dew point.
- B. Existing Conditions:
1. Surface Conditions: Surfaces receiving firestopping must be dry. Install firestopping only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- C. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. 3M Fire Protection Products.
 2. Hilti, Inc.
 3. Specified Technologies, Inc.

2.3 FIRESTOPPING ASSEMBLIES

- A. Description:
1. Through-Penetration Firestop Systems: Provide firestop systems tested and identified in UL's "*Fire Resistance Directory*" product Category XHEZ, or equal.
 2. Fire-Resistive Joint Systems (fire calks): Provide firestop systems tested and identified in UL's "*Fire Resistance Directory*" product Category XHBN, or equal.
 3. Perimeter Fire-Resistive Joint Systems (safing insulation): Provide firestop systems tested and identified in UL's "*Fire Resistance Directory*" product Category XHDG, or equal.
- B. Requisite Properties:
1. F-Rated Firestop Systems: Provide firestop systems in fire partitions having an F rating that meets or exceeds the fire-resistance rating of the penetrated construction, but not less than one-hour.
 2. T-Rated Firestop Systems: In fire-resistive floor-ceiling or roof-ceiling construction, or other constructions where penetrating items pass through occupied areas and may contact combustible materials, provide firestop systems having both an F- and a T-rating, determined in conformance with ASTM E 814 or UL 1479. T-rated assemblies are required where the following conditions exist with exceptions.
 - a. Where firestop systems protect floor penetrations located outside of wall cavities.
 - b. Where firestop systems protect floor penetrations located outside fire-resistive shaft enclosures.
 - c. Where firestop systems protect penetrations located in fire-resistive construction containing doors required to have a temperature-rise rating.
 - d. Where firestop systems protect penetrating items larger than a 4-inch diameter nominal pipe or 16 square inches in overall cross-sectional area.
 3. L-Rated Firestop Systems: Where firestop systems are indicated in smoke barriers and elsewhere, provide penetration firestop systems with an L-rating of not more than 5.0 cubic feet per minute per square foot both at ambient temperatures and at 400 deg. F.
 4. Firestopping Exposed to Traffic, Moisture, or Physical Damage: Provide products that do not deteriorate after curing.
 5. Plumbing and Wet-Pipe Sprinkler System Piping Penetrations: Provide moisture-resistant penetration firestop systems.
 6. Penetrations with Insulated Piping: Provide penetration firestop systems that do not require piping insulation removal.

7. Floor penetrations with Annular Spaces Exceeding 4 inches Wide and Exposed to Possible Loading and Traffic: Provide firestop systems that support floor loads involved, either by installing floor plates or by other means.
8. Surface-Burning Characteristics: Provide firestopping having a maximum FSI Value of 0 and a maximum SDI Value of 0 (Class A), when tested in conformance with ASTM E 84.

2.4 MATERIALS

- A. Latex Sealant: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- B. Silicone Sealant: Single-component, silicone-based, neutral-curing elastomeric sealants. Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces; non-sag formulation for openings in walls and other vertical and overhead surfaces.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomer that, when mixed, expands and cures in place to produce a flexible, non-shrinking foam.
- D. Intumescent Putty: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Intumescent Blocks: Intumescent flexible block based on a two-component polyurethane foam
- G. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- H. Pillows and Bags: Reusable heat-expanding pillows and bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- I. Pre-formed Mineral Wool: Designed to fit flutes of metal decking and the gap between the top of wall and metal decking as a backer for spray material.
- J. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors, consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket, including similar devices.
- K. Pre-Installed Firestop Devices: Factory-assembled devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and cable bundles penetrating concrete floors or gypsum board walls.
- L. Metal Track Firestopping:

1. Description: Top- and bottom-of-wall metal tracks to fills gaps between the metal and concrete surfaces and help seal out fire and smoke sound drafts.
2. Product: "Firestop Top Track Seal CFS-TTS" manufactured by Hilti, or equal.

M. Fire Rated Cable Pathways:

1. Description: Gangable device modules consisting of steel raceways with intumescent foam pads requiring no additional action to achieve fire and leakage ratings, including plugs, twisting closure, putty, pillow, or sealant.
2. Products: "EZ-PATH Series 44+ Fire Rated Pathway" manufactured by Specified Technologies, Inc., or equal.
3. Requisite Properties:
 - a. Size: 4 inches wide by 4-5/8 inches high by 14 inches long.
 - b. Material: 0.059-inch BMT (MSG 18) galvanized steel sheet.

2.5 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 MIXING

- A. Open firestopping containers only as required for use and mix only in designated areas.
- B. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- C. Do not reduce, alter, or introduce foreign materials into firestopping, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 2. Verify substrates are dry and free of deleterious and other substances that might interfere with firestopping adhesion, appearance, or performance.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and firestopping installation.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

A. General Requirements:

1. Install firestopping using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install firestopping under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. Fireproofing surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed firestopping must be warrantable. Do not install, correct, or replace firestopping in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Prime substrates as required, recommended, approved, or accepted by the manufacturer, using the manufacturer's recommended products and methods.
 - a. Confine primers to bond areas.
 - b. Do not allow spillage and migration onto exposed surfaces

2. Install forming, damming, and backing materials and other accessories as required to support fill materials during installation in the positions needed to produce cross-sectional shapes and depths required for indicated fire ratings.
3. Verify wet film thickness of firestopping during application by taking numerous measurements with a wet film gage.
4. After installing fill materials and allowing them to fully cure, remove forming materials and other accessories not indicated as permanent components of the firestopping systems.
 - a. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required achieving fire-resistance ratings indicated.
 - b. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - c. Where fill materials remain exposed after installation, produce uniform finished surfaces without substrates, undercoats, marks, or stains showing through. Produce sharp and even lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Site Inspections:

1. General: Include site inspections as part of the work of this specification section. The Owner's testing and inspection agency performs inspections.
 - a. Schedule and arrange all inspections.
 - b. Coordinate all work and the final construction schedule with all inspections.
 - c. Coordinate inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
2. Required Inspections: Inspections are performed in conformance with the requirements of ASTM E 2174 (through penetration fire stops) and ASTM E 2393 (fire resistive joint systems and perimeter fire barriers).

3.5 CORRECTION AND REPAIR

- #### A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 PROTECTION

- A. Protect installed firestopping in place from deterioration and damage until covering firestopping or Substantial Completion.
- B. Do not store anything adjacent to or against installed firestopping unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed firestopping surfaces as work surfaces.
- C. Remove protection when it's no longer needed and before covering firestopping or Substantial Completion.

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SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Traffic sealants.
2. Exterior façade sealants.
3. Interior joint sealants.
4. Joint sealant backings.
5. Surface preparation.
6. Site tests and inspections.
7. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 81 00 for structural silicone sealants for glazing applications.
3. Section 09 81 33 for acoustical sealants.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the sealant manufacturer, unless otherwise indicated.
2. Ultra-Low Modulus: Means having a joint movement extension/compression capability of at least a 100-percent increase and at least a 50-percent decrease, when tested in conformance with ASTM C 719.
3. Low Modulus: Means having a joint movement extension/compression capability of at least a 50-percent increase and at least a 50-percent decrease, when tested in conformance with ASTM C 719.
4. Medium Modulus: Means having a joint movement extension/compression capability of at least a 35-percent increase and at least a 35-percent decrease, when tested in conformance with ASTM C 719.
5. High Modulus: Means having a joint movement extension/compression capability of at least a 25-percent increase and at least a 25-percent decrease, when tested in conformance with ASTM C 719.
6. Very High Modulus: Means having a joint movement extension/compression capability of at least a 12.5-percent increase and at least a 12.5-percent decrease, when tested in conformance with ASTM C 719.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified sealants are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.

B. Performance Requirements:

1. Joint sealants must establish and maintain a continuous watertight seal without staining substrates or deterioration.
2. Sealants installed in contact with porous substrates must demonstrate testing in conformance with ASTM C 1248 resulting in no staining to porous materials identical to those indicated for this project.

C. Preinstallation Meeting:

1. Hold a meeting after preliminary preparation of specified submittals and before issuing submittals to the Architect for review and approval.
 - a. Sealant manufacturer's representative and distributor must attend meeting.
 - b. Sealant installer and the same installer's personnel designated to perform the work of this specification section must attend meeting.
 - c. Architect and waterproofing consultant must attend meeting.
2. During the meeting, review the Contract Documents, preliminary submittals, in-service project conditions, and installation sequence and methods, including special details and conditions that might affect installation.
 - a. Review, discuss, and schedule preconstruction testing to determine chemical and adhesive compatibility of all materials, joint substrates, shims, setting blocks, joint sealant backings, secondary seals, and other materials that will contact or affect joint sealants. Obtain joint-sealant manufacturer's instructions for corrective measures for items failing tests.
 - b. Review and discuss sealant backings, including backing types, materials, configurations, sizes, installed depths relative to joint widths, and other criteria.
 - c. Review and discuss substrate preparation, including whether priming and other specific joint preparation techniques are necessary or required to obtain optimum adhesion of joint sealants to joint substrates.
 - d. Review and discuss sealant mixing, installation, and tooling, including joint configurations relative to ASTM C 1193 and those indicated on the Drawings.
 - e. Review and discuss field testing, including both non-destructive and destructive testing procedures, subsequent evaluation and corrective measures for items failing tests, and repair of damaged sealants.
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed sealants. Resolve each condition.
4. Finalize construction schedule.

5. Record significant discussions and distribute meeting minutes. Do not make submittal to the Architect for review and approval until disagreements are successfully resolved to the satisfaction of all parties.

- D. Scheduling: Schedule cleaning to prevent dust and other contaminants from falling on freshly-applied sealants.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data:
 - a. Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Samples: Submit at least 6-inch long representative samples of each sealant variety in each selected color.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished joint sealants.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.

2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Joint sealants must be obtained through one source from the same manufacturer (to ensure compatibility and a uniform appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing sealants installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Installer: Company or individuals must have at least 5 years' experience installing joint sealants for at least 30 previous projects similar to this project in size, material, design, and complexity. Installers and supervisors must be
3. Supervisors: Individuals must have at least 7 years' experience installing joint sealants for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading joint sealant installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
 - 1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 - 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 - 1. Avoid damage to packaging and containers, and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective sealant materials with undamaged new sealants materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install joint sealants only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
 - 1. Do not install joint sealants during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 - 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
 - 3. Do not apply joint sealants when
 - a. ambient temperature is below 45 deg. F or more than 90 deg. F during application, and for at least 8 hours after;
 - b. surface temperatures are less than 40 deg. F or greater than 120 deg. F; and
 - c. surface temperatures are 5 deg. F or less above the dew point.
- B. Existing Conditions:

1. Surface Conditions: Surfaces receiving joint sealants must be dry. Install joint sealants only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.
- C. Other Conditions: Do not apply sealants where dust is generated, or liquids are sprayed.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years (urethane sealants) and 20 years (silicone sealants).
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Silicone Sealant Manufacturers: Provide products manufactured by one of the following, or equal. Private label and third-party-manufactured sealants are prohibited.
 1. Dow Corning Corp.
 2. Momentive Performance Materials, Inc.
- B. Polyurethane Sealant Manufacturers: Provide products manufactured by one of the following, or equal.
 1. BASF Building Systems.
 2. Pecora Corp.
 3. Sika Corp.
- C. Acrylic Latex Sealant Manufacturers:
 1. LATICRETE International, Inc.
 2. Pecora Corp.
 3. Tremco, Inc.

2.3 TRAFFIC JOINT SEALANTS

- A. Self-Leveling Polyurethane Traffic Sealant:
 1. Application: Used to weather seal interior and exterior flat walkways, plazas, decks, parking garages, and similar horizontal installation joints subject to pedestrian or vehicular traffic.
 2. Description: Single-component polyurethane sealant conforming to ASTM C 920 requirements for Type S, Grade P, Class 25, Use T, M or O sealant, as applicable.
 3. Product: Provide one of the following, or equal.
 - a. "Sonneborn Sonolastic SL 1" manufactured by BASF Building Systems.
 - b. "Urexpan NR-201" manufactured by Pecora Corp.
 - c. "Sikaflex-1c SL" manufactured by Sika Corp.
 4. Colors: Selected by the Architect from the manufacturer's standard colors.
- B. Non-Sag Polyurethane Traffic Sealant:

1. Application: Used to weather seal interior and exterior sloped walkways, plazas, decks, parking garages, and similar sloped installation joints subject to pedestrian or vehicular traffic.
2. Description: 2-component polyurethane sealant conforming to ASTM C 920 requirements for Type M, Grade NS, Class 25, Use T, NT, M, G, A, O, or I sealant, as applicable.
3. Product: "Sikaflex-2c NS" manufactured by Sika Corp., or equal.
4. Colors: Indicated on the Drawings or selected by the Architect.

2.4 EXTERIOR FACADE SEALANTS

A. Ultra-Low Modulus Silicone Sealant:

1. Description: Neutral-curing silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 100/50, Use NT, A or O sealant, as applicable.
2. Application: Used for sealing expansion and control joints, precast concrete panel joints, EIFS joints, curtainwall joints, mullion joints, stone pavers, and other exterior building joints subject to extreme or dynamic movement.
3. Products: Provide one of the following, or equal.
 - a. "DOWSIL 790" manufactured by Dow Corning Corp.
 - b. "GE SCS 2700 SilPruf LM" manufactured by Momentive Performance Materials, Inc.
4. Colors: Selected by the Architect from the manufacturer's standard colors.

B. Low Modulus Silicone Sealant:

1. Description: Neutral-curing silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 50, Use NT, M, G, A or O sealant, as applicable.
2. Application: Used for weatherproofing building facade materials, including glass, aluminum, steel, painted metal, EIFS, granite and other stone, concrete, brick and plastics.
3. Products: Provide one of the following, or equal.
 - a. "DOWSIL 795" manufactured by Dow Corning Corp.
 - b. "GE SCS 2000 SilPruf LM" manufactured by Momentive Performance Materials, Inc.
4. Colors: Selected by the Architect from the manufacturer's standard colors.

C. Butyl Sealant:

1. Description: Single-component, solvent-release plasticized polyisobutylene (butyl rubber) conforming to ASTM C 1311.
2. Application: Applied to weather seal joints between sheet metal flashings and substrates.
3. Color: Black.

2.5 SPECIALTY JOINT SEALANTS

A. Low Modulus Porous Surface Sealant:

1. Description: Neutral-curing silicone sealant conforming to ASTM C 920 for Type S, Grade NS, Class 50, Use NT, M, G, A or O sealant, as applicable.
2. Application: Used for weatherproofing exterior building joints in sensitive porous stone requiring reduced substrate staining; and with metal panel substrates requiring reduced residue rundown.
3. Products: Provide one of the following, or equal.
 - a. "756 SMS" manufactured by Dow Corning Corp.
 - b. "GE SCS 9000 SilPruf NB" manufactured by Momentive Performance Materials, Inc.
4. Colors: Selected by the Architect from the manufacturer's standard colors.

2.6 INTERIOR JOINT SEALANTS

A. Single-Component Damp Location Sealant:

1. Description: Medium or high modulus mildew-resistant silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 25, Use NT, A or O sealant, as applicable.
2. Products: Provide one of the following, or equal.
 - a. "786" manufactured by Dow Corning Corp.
 - b. "Sanitary SCS 1700" manufactured by Momentive Performance Materials, Inc.
3. Colors: White or clear, as selected by the Architect.

B. General Purpose Interior Sealant:

1. Description: Siliconized acrylic-latex sealant conforming to ASTM C 834 requirements for Type OP, Grade NF classification, as required.
2. Products: Provide one of the following, or equal.
 - a. "Sonneborn Sonolac" manufactured by BASF Building Systems.
 - b. "AC-20+Silicone" manufactured by Pecora Corp.
 - c. "Tremflex 834" manufactured by Tremco, Inc.
3. Colors: Selected by the Architect from the manufacturer's standard colors.

2.7 JOINT SEALANT BACKINGS

A. Closed Cell Foam Joint Backing:

1. Description: Extruded polyethylene foam cylindrical sealant backings conforming to ASTM C 1330, Type C.
2. Application: Provide closed-cell backer rod at all exterior applications unless otherwise indicated on the Drawings.
3. Products: Provide one of the following, or equal.
 - a. "Mile High Foam" manufactured by Backer Rod Mfg. Inc.

- b. "HBR" or "Green Rod" manufactured by Nomaco, Inc.
- c. "NuFlex 870" manufactured by TVM Building Products.
- 4. Performance Requirements:
 - a. Maximum Water Absorption: Not more than 0.10 grams per cubic centiliter when tested in conformance with conformance with ASTM C 1016, Procedure B.
 - b. Minimum Density: At least 24 per cubic meter when tested in conformance with conformance with ASTM D 1622.
 - c. Maximum Outgassing: Less than 1 bubble when tested in conformance with conformance with ASTM D 1253.
 - d. Minimum Compression Recovery: At least 90 percent, when tested in conformance with conformance with ASTM D 5249.
 - e. Minimum Compression Deflection: At least 20.5 percent, when tested in conformance with conformance with ASTM D 5249.
 - f. Minimum Tensile Strength: At least 200 kPa, when tested in conformance with conformance with ASTM D 1623.
- B. Open Cell Foam Joint Backing:
 - 1. Restrictions: Permitted only for interior use, and as the second (interior) line of a double-line sealant application.
- C. Bi-Cellular (Dual-Cell) Foam Joint Backings:
 - 1. Description: Extruded polyethylene foam cylindrical sealant backings conforming to ASTM C 1330, Type B.
 - 2. Restrictions: Permitted only for interior use. Only bi-cellular (dual-cell) foam may be used as a backing for single-component (air-cure) materials.
 - 3. Products: "Sof Rod" or "Dual Rod" manufactured by Nomaco, Inc., or equal.
 - 4. Performance Requirements:
 - a. Maximum Water Absorption: Not more than 0.10 grams per cubic centiliter when tested in conformance with conformance with ASTM C 1016, Procedure B.
 - b. Density: At least 24 kilograms per cubic meter when tested in conformance with conformance with ASTM D 1622.
 - c. Maximum Outgassing: Less than 1 bubble when tested in conformance with conformance with ASTM D 1253.
 - d. Minimum Compression Recovery: At least 90 percent, when tested in conformance with conformance with ASTM D 5249.
 - e. Minimum Compression Deflection: At least 20.5 percent, when tested in conformance with conformance with ASTM D 5249.
 - f. Minimum Tensile Strength: At least 200 kPa, when tested in conformance with conformance with ASTM D 1623.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

- E. Prefabricated Backer Seal: "BackerSeal" manufactured by Emseal Joint Systems, Ltd., or equal.

2.8 TAPE SEALANTS

- A. Foam Tape:
 - 1. Description: Closed-cell, compressible PVC foam with pressure-sensitive adhesive.
 - 2. Product: "NORSEAL" foam tape manufactured by Saint-Gobain Performance Plastics, or equal.
- B. Pre-Formed Silicone Sheet:
 - 1. Applications: Used at barrier transitions to rough openings.
 - 2. Product: "Dow Corning 123 Silicone Seal" manufactured by Dow Corning Corp., or equal.
 - 3. Colors: Selected by the Architect from the manufacturer's standard colors.

2.9 ACCESSORIES

- A. Primer and Surface Cleaners:
 - 1. Application: Applied to enhance and strengthen sealant adhesion to porous and nonporous substrates; and help ensure proper joint preparation
 - 2. Porous and Cementitious Surfaces: "1200 OS Primer" manufactured by Dow Corning Corp., or equal.
 - 3. Other Surfaces: "Construction Primer P" manufactured by Dow Corning Corp., or equal.
- B. Masking Tape: Provide paper masking tape manufactured by 3M, or equal, unless another kind is supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.10 MIXING

- A. Open sealants containers only as required for use and mix only in designated areas.
- B. Do not reduce, alter, or introduce foreign materials into sealants, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify joint dimensions and joint backer sizes conform to width-to-depth ratios, neck dimensions, and surface bond areas required, recommended, or accepted by the manufacturer.
 - 3. Verify substrates are dry and free of deleterious and other substances that might interfere with joint sealant adhesion, appearance, or performance.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and joint sealant installation.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
- B. Substrate Preparation:
 - 1. Prepare substrates in conformance with ASTM C 1193 and as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 - 2. Remove loose materials and foreign matter that may impair sealant adhesion.
 - 3. Clean and prime substrates as required, recommended, or accepted by the manufacturer, using the manufacturer's recommended products and methods.
 - a. Confine primers to bond areas.
 - b. Do not allow spillage and migration onto exposed surfaces

3.3 INSTALLATION

A. General Requirements:

1. Install joint sealants in conformance with ASTM C 1193 using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install joint sealants under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. Joint sealant surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work. Produce sharp and even lines and color breaks.
4. Completed work must match approved samples and mockups, as accepted by the Architect.
5. Installed joint sealants must be warrantable. Do not install, correct, or replace joint sealants in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Install sealant backings 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.
 - a. Install sealants free of air pockets, foreign embedded matter, ridges, and sags.
 - b. Do not leave gaps between ends of sealant backings.
 - c. Do not stretch, twist, puncture, or tear sealant backings.
 - d. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
2. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
3. Size materials to achieve required width/depth ratio.
4. Install sealants using proven techniques that conform to the following and at the same time backings are installed:
 - a. Place sealants so they directly contact and fully wet joint substrates.
 - b. Completely fill recesses in each joint configuration.
 - c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - d. Employ installation techniques that ensure joint sealers are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of bond surfaces equally on opposite sides.
 - e. Joint configuration: Fill sealant joint to a slightly concave surface, slightly below adjoining surfaces, unless otherwise indicated.
 - f. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form a slight cove, so that joint will not trap moisture or dirt.
5. Promptly after sealant application, and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

- a. Remove excess sealant from surfaces adjacent to joints.
- b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- c. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
- d. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
- e. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.
6. Preformed Silicone-Sealant System:
 - a. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
 - b. Apply silicone sealant to each side of joint to produce a bead of size conforming to the preformed silicone-sealant system manufacturer's instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
 - c. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
 - d. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.
7. Preformed Foam Sealant Special Techniques:
 - a. Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material.
 - b. Produce seal continuity at ends, turns, and intersections of joints.
 - c. For applications at low ambient temperatures, apply heat to sealant in conformance with sealant manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

A. Site Tests and Inspections:

1. General: Include site inspections as part of the work of this specification section. The Owner's testing and inspection agency performs inspections.
 - a. Schedule and arrange all inspections.
 - b. Coordinate all work and the final construction schedule with all inspections.
 - c. Coordinate inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site inspections.

- g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
- 2. Porous Substrate Stain Testing: Procedures must conform to ASTM C 510.
- 3. Non-Destructive Spot Testing: Procedures must conform to ASTM C 1521.
 - a. The center of sealant beads is depressed with a blunt dowel-shaped probing tool to depth of 50 percent of the bead width.
 - b. If sealant fails, then the failure is recorded along with whether the failure was an adhesive or cohesive failure, and the maximum surface depression as a percentage of joint width.
 - c. Tests are performed every 12 inches for first 10 linear feet of each joint; if test failure is not observed, then tests are performed every 24 inches thereafter.
- 4. Non-Destructive Continuous Inspection: Procedures must conform to ASTM C 1521.
 - a. Certain sealant quantities, locations, and lengths up to 100-percent inspection of an entire assembly sealant may be chosen by the Architect for general sealant assessment, including joint configurations known to be difficult to install, changes in sealant and substrate types, or other quantities and locations.
- 5. Destructive Testing: Procedures must conform to ASTM C 1521.
 - a. A 3-inch-long tab is cut into the sealant bead.
 - b. The tab is marked one inch from the beginning of the adhesive bond away from the cut tail.
 - c. The tab is grasped one inch from the beginning of the adhesive bond and pulled until it extends to 2 times the published movement capability of the sealant. If sealant does not fail, it is then pulled to failure.
 - d. Elongation at the point of failure is recorded along with whether the failure was an adhesive or cohesive failure.
 - e. Sealant is then observed during the complete filling of the joint for the presence of voids, for joint configuration, and for conformance with specified requirements. Observations and sealant dimensions are recorded.
 - f. 10 tests are performed for the first 1,000 linear feet of joint for each type of sealant and substrate; if failure at two times the movement capability is not observed, then one test is performed for either every 1,000 linear feet thereafter or at a rate of one test per floor per building elevation, whichever is more frequent.
- 6. After testing is complete, promptly replace failed sealants in test areas.
 - a. Neatly cut out and remove failed sealant, prepare and prime surfaces, and install new sealant.
 - b. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Cleaning Work: Clean sealant from adjacent surfaces.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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DIVISION 08

OPENINGS

SECTION 08 12 13 – STANDARD HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal door frames.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. BMT: Base Metal Thickness.
2. DHI: Door Hardware Institute.
3. HM: Hollow Metal.
4. MSG: Manufacturer's Standard Gage.
5. DI: Steel Door Institute.

B. Definitions:

1. Manufacturer: Means the door frame manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with door frame manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. **Product Data:** Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. **Door Schedule:** Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, undercuts, and finishes. Use the same reference numbers for openings and details as the Drawings.
 3. **Shop Drawings:** Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to door schedule.
- B. **Informational Submittals:** Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. **Manufacturer's Instructions:** Submit manufacturer-prepared published instructions for proper installation of furnished door frames.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. **Qualification Statements:** Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. **Sustainable Design Submittals:**
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. **Source Limitations:**
1. Door frames must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).

- a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
- b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Quality Standard Requirements:

1. Manufacturing Tolerances: Comply with the requirements of ANSI/SDI publication ANSI/SDI A250.8, *"Recommended Specifications for Standard Steel Doors and Frames"*.
2. Door Frame Installation Standards:
 - a. Install fire-resistance rated frames in conformance with NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"*.
 - b. Install other frames in conformance with of ANSI A250.11, *"Recommended Erection Instructions for Steel Frames"*.
3. Hardware Preparations and Reinforcement: Comply with the requirements of ANSI/SDI A250.6, *"Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames"* with reinforcing plates fabricated from the same material as door face sheets.
4. Door Hardware Installation Standards: Install door frame hardware in conformance with ANSI/DHI A115-IG, *"Installation Guide for Doors and Hardware"*.

C. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing door frames installed on at least 200 previous projects similar to this project in size, material, design, and complexity. Manufacturer must be a current member of SDI.
2. Installer: Company or individuals must have at least 5 years' experience installing door frames for at least 30 previous projects similar to this project in size, material, design, and complexity. Installer must be a current member of SDI.
3. Supervisors: Individuals must have at least 7 years' experience installing door frames for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading door frame installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
 3. Across the bottom of welded frames, at least 2 removable spreader bars must be tack welded to jambs and mullions.

4. Frames must be palletized, wrapped, or crated to provide protection during transit and site storage.
- B. Storage: Store unloaded items as shipped, upright, and indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
- C. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Allegion PLC.
 2. ASSA ABLOY.
 3. Door Components, Inc.
 4. MPI Custom Steel Doors and Frames.
 5. Republic Doors and Frames.

2.3 STANDARD HOLLOW METAL FRAMES

- A. Description: 3-sided (open), fully welded masonry (universal) and flush drywall standard HM frames conforming to the requirements of Steel Door Institute publication SDI-100, *Recommended Specifications for Standard Steel Doors and Frames*.
- B. Products: "Steelcraft" frames manufactured by Allegion, or equal.
1. Single Egress Door HM Frames: "F-Series" frames, or equal.

2.4 COMPONENTS

- A. Materials:
1. Frames with an Uncoated Finish (Bare or Natural Finish): Fabricate from zinc coated (HDG) steel sheet or from stainless steel sheet, as indicated.
 2. Exterior Frames with a Painted Finish and Interior Frames Installed in Wet or High Humidity Locations (including shower rooms and toilet rooms): May be fabricated from either zinc-iron alloy coated (galvannealed) steel sheet or stainless steel sheet.
 3. Interior Frames Installed Elsewhere: Fabricate from uncoated CRS sheet.

4. Sidelight and Transom Frames: Fabricate from the same material, thickness, and finish as the adjacent door frame.
- B. Material Thickness:
1. HM Frames for Level 1 and Physical Performance Level C (Standard Duty) Doors: Fabricate from at least 0.0478-inch BMT (MSG 18) uncoated and zinc-coated steel sheet; or from at least 0.0500-inch (USSG 18) stainless steel sheet.
 2. HM Frames for Level 2 (Heavy Duty) and Physical Performance Level B, and for Level 3 and Physical Performance Level B (Extra Heavy Duty) Doors: Fabricate from at least 0.0598-inch BMT (MSG 16) uncoated steel and zinc-coated steel BMT; or from at least 0.0625-inch BMT (USSG 16) stainless steel sheet.
 3. HM Frames for Level 3 and Physical Performance Level B (Extra Heavy Duty) Doors: Fabricate from at least 0.0598-inch BMT (MSG 16) uncoated steel and zinc-coated steel BMT; or from at least 0.0625-inch BMT (USSG 16) stainless steel sheet.
 4. HM Frames for Level 4 and Physical Performance Level A (Maximum Duty) Doors: Fabricate from at least 0.0747-inch BMT (MSG 14) uncoated and zinc-coated steel sheet, or at least 0.0781-inch (USSG 14) stainless steel sheet.
 5. Other HM Frames: Fabricate from at least 0.0598-inch BMT (MSG 16) uncoated steel and zinc-coated steel BMT; or from at least 0.0625-inch BMT (USSG 16) stainless steel sheet.
- C. Profiles:
1. Types: Indicated on the Drawings.
 2. Throat Openings:
 - a. Butted Frames: Equal to the wall or partition type thickness minus twice the frame return dimension, unless otherwise indicated.
 - b. Wrap-Around Frames: Equal to the wall or partition thickness, unless otherwise indicated.
 3. Frame Depth:
 - a. Butted Frames: Equal to the wall or partition thickness.
 - b. Wrap-Around Frames: Equal to the throat opening plus twice the frame return dimension.
 4. Frame Return Dimension: 1/2-inch.
 5. Backbend Dimension (Second, Double, or Drywall Return Dimension): At least 3/8-inch.
 6. Backbend Type: Indicated on the Drawings.
 7. Face Dimension: Provide 4-inch face dimension at heads in CMU construction where required to maintain a masonry module; provide 2-inch face dimension at jambs. Provide 2-inch face dimension elsewhere, unless otherwise indicated.
 8. Stop Dimension: 5/8-inch.
 9. Rabbet Depth Dimension: Equal to 3/16-inch greater than the door thickness.
 10. Opposite Door Rabbet Depth Dimension: 1-9/16 inches.
 11. Soffit Dimension: Equal to the frame depth minus the sum of the rabbet dimensions.

D. Corners:

1. Welded HM Door Frames: Provide square-cut mitered or coped and mitered, set-up arc welded (SUA) and ground smooth, full profile welded frames (fully welded or continuously welded frames) for installation of frames as a complete unit. All corners must be watertight.
2. HM Frame Glazing Beads: Provide butted corners.

E. Hardware Preparations and Reinforcement: Provide HM frame hardware reinforcing and preparations in conformance with ANSI/SDI publications A250.6, *“Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames”* and A250.8, *“Recommended Specifications for Standard Steel Doors and Frames”*.

2.5 ACCESSORIES

A. Head Reinforcement: For opening widths greater than 48 inches wide, provide channel or angle stiffeners fabricated from at least 0.0747-inch BMT (MSG 14) zinc coated (HDG) steel sheet or at least 0.0781-inch BMT (USSG 14) stainless steel sheet, as applicable.

B. Anchors:

1. Masonry Anchors: Provide either 3/16-inch minimum diameter (SWG 7) galvanized carbon steel masonry wire anchors or at least 0.0598-inch BMT (MSG 16) zinc coated (HDG) steel sheet masonry tee anchors, as applicable.
2. Existing Opening Anchors: Provide at least 16-gage welded pipe sleeve anchors with 0.0598-inch BMT (MSG 16) zinc coated (HDG) steel sheet straps designed specifically to add support for bolting frames into rough openings of an existing walls.
3. Wood Stud Anchors: Provide either at least 0.0598-inch BMT (MSG 16) zinc coated (HDG) steel sheet anchors designed specifically for attachment to the wood studs of a rough opening.
4. Metal Stud Anchors: Provide either at least 0.0598-inch BMT (MSG 16) zinc coated (HDG) steel sheet anchors designed specifically for attachment to the webbing of the closed steel studs built around the frame.
5. Universal Stud Wall Anchors: Provide either at least 0.0598-inch BMT (MSG 16) zinc coated (HDG) steel sheet universal lock-in jamb anchors designed specifically for use in either wood or steel stud wall applications, as applicable.
6. Base Anchors: Provide either at least 0.0598-inch (MSG 16) BMT zinc coated (HDG) steel sheet or at least 0.0625-inch BMT (USSG 16) stainless steel sheet base anchors, as applicable. Provide adjustable base anchors that allow for installation adjustment when the floor is not level.

C. Electrical Device Requirements: Make provisions for installation of electrified hardware and door electrical devices, and arrange so that wiring is readily installed, removed, and replaced.

1. Provide cutouts and reinforcement required for installation of devices.
2. Provide metal conduits or raceways to accommodate wiring between devices. (e.g., from electric hinge to other electric door hardware)

- D. Glazing Stops:
 - 1. Fire-Rated Conditions: Provide 3/4-inch square channel glazing beads.
 - 2. Elsewhere: Provide 5/8-inch square channel glazing beads.
 - 3. Material Thickness: Fabricate from at least 0.0478-inch BMT (MSG 18) uncoated and zinc-coated steel sheet.
- E. Silencers: Provide loose, 1/8-inch thick by 1/2-inch wide pressure-sensitive-adhesive-backed polychloroprene (Neoprene) or ethylene propylene diene monomer (EPDM) rubber silencers for field installation. Furnish at least 3 for each strike jamb and at least 2 for double door head. Do not provide silencers where they may interfere with other seals, including smoke & draft seals.
- F. Filler: Provide material conforming to the requirements of ANSI/SDI publication A250.8, *"Recommended Specifications for Standard Steel Doors and Frames"*. Use UL-listed materials in frames scheduled as having a fire-resistance rating.
- G. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 MATERIALS

- A. Uncoated Carbon Steel Sheet:
 - 1. Frame Material: Finished CRS coil, sheet, and strip conforming to ASTM A 1008, CS Type B (commercial steel), exposed, temper rolled, regular matte surface finish (40 to 59 AA), and oiled (sheet must be thoroughly cleaned to remove the oil prior to painting).
 - 2. Hardware Reinforcements: HRS coil, sheet, and strip conforming to ASTM A 1011, CS Type B (commercial steel), as-rolled surface finish, with cut edges.
- B. Zinc-Iron Alloy Coated (Galvannealed) Steel Sheet: ASTM A 653, CS Type B (commercial steel), with equal coating weight on each surface.
 - 1. Coating Weight (Mass) Designation: Provide at least a A60 (galvannealed) minimum coating weight (mass) designation.
 - 2. Surface Finish: Non-spangled matte finish.
 - 3. Surface Treatment: Provide mill phosphate surface treatment (paint-grip finish - provides enhanced lubricating characteristics).
- C. Zinc Coated (HDG) Steel Sheet: ASTM A 653, CS Type B (commercial steel), with equal coating weight on each surface.
 - 1. Coating Weight (Mass) Designation: Provide at least a G90 (galvanized) minimum coating weight (mass) designation.
 - 2. Surface Finish: Provide regular spangle surface finish.
 - 3. Surface Treatment:

- a. Exterior Frames: Provide oil over chemical surface treatment (chemical treatment desired for humid-storage stain resistance and oil treatment needed for enhanced formability).
- b. Interior Frames: Provide oiled surface treatment (needed for enhanced formability).

2.7 FINISHES

- A. Uncoated Steel HM Frames: Provide shop-applied phosphate (paint-grip) pre-treatment and baked on rust inhibitive primer. Primer must be compatible with either field-applied paint or field-applied coating systems specified in Division 09, as applicable.
- B. Zinc Coated and Zinc-Iron Alloy Coated Steel and Stainless Steel HM Frames: Provide shop-applied bonderized pre-treatment. (not prime painted)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install door frames in conformance with the quality standards publications using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction

3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 4. Installed door frames must be warrantable. Do not install, correct, or replace door frames in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Frames: Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install frames with removable glazing stops located on secure side of opening.
 - b. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - c. Install door silencers in frames before grouting.
 - d. Provide setting spreaders, supplied by the installer, and leave intact until frames are set square and plumb within specified tolerances, and all anchors are securely attached and grouted where required.
 - e. Remove frame spreader bars only after frames are properly set and secured. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
 5. Ceiling Struts: Except where anchored to masonry or to other structural support at each jamb, extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame.
 - a. Bend top of struts to provide flush contact for securing to supporting construction.
 - b. Provide adjustable wedged or bolted anchorage to frame jamb members.
 6. Glazing: Comply with installation requirements in Section 08 81 00 and with the manufacturer's instructions. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches O.C. and not more than 2 inches on center from each corner.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach door frames to supporting construction.
- D. Installation Tolerances: Install frames within the following tolerance variations.
1. Maximum Out of Square: Not more than 1/16-inch, measured at rabbet on 90 degrees from jamb perpendicular to frame head.
 2. Maximum Out of Alignment: Not more than 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.

3. Maximum Twist: Not more than 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Maximum Out of Plumb: Not more than 1/16-inch, measured on floor at jambs.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible door frame surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed door frames in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything adjacent to or against installed door frames unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed door frames as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 12 16 – ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum door frames.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the aluminum frame manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with door frame manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label

- requirements, undercuts, and finishes. Use the same reference numbers for openings and details as the Drawings.
3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 4. Samples: Submit at least 8-inch long representative samples of each aluminum frame color, finish, and variety.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Submit manufacturer-prepared published instructions for proper installation of furnished aluminum frames.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
1. Aluminum frames must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.

2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective aluminum frames with undamaged new aluminum frames that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.

3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.

2.2 MANUFACTURER

- A. Manufacturers: Provide products manufactured by one the following, or equal.
 1. Wilson Partitions.
 2. Alpha Aluminum Products.
 3. Western Integrated Materials, Inc.

2.3 ALUMINUM FRAMES

- A. Description: Pre-finished, knock-down, extruded aluminum door frames consisting of separate strike jamb, hinge jamb, and header. Hollow metal frames with aluminum caps are prohibited.
- B. Product: "Snap-On Trim Profile" manufactured by Wilson Partitions, or equal.
- C. Requisite Properties:

1. Frame Profiles: Indicated on the Drawings per wall thickness, or equal.
 - a. "Series 458" for 4-5/8-inch partitions.
 - b. "Series 487" for 4-7/8-inch partitions.
 - c. "Series 500" for 5-inch partitions.
 - d. "Series 525" for 5-1/4-inch partitions.
 - e. "Series 725" for 7-1/4-inch partitions.
 - f. "Series 200" for 3- to 9-1/2-inch partitions.
2. Casing:
 - a. with 1-1/2-inch trim.
3. Material: At least 0.125-inch thick extruded aluminum conforming to ASTM B 221.
4. Hardware Preparations: Manufacturer's standard reinforcements for each applicable hardware group specified in Section 08 71 00.
5. Finish: Manufacturer's standard black anodized finish.

2.4 ACCESSORIES

- A. Silencers: Provide manufacturer's standard silencers.
- B. Glazing Gaskets: Manufacturer's standard, sized to accommodate glazing thickness indicated.
- C. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install aluminum frames using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed aluminum frames must be warrantable. Do not install, correct, or replace aluminum frames in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach aluminum frames to supporting construction.

C. Installation Tolerances: Install frames within the following tolerance variations.

1. Maximum Out of Square: Not more than 1/16-inch, measured at rabbet on 90 degrees from jamb perpendicular to frame head.
2. Maximum Out of Alignment: Not more than 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Maximum Twist: Not more than 1/16-inch, measured at at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Maximum Out of Plumb: Not more than 1/16-inch, measured on floor at jambs.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible aluminum frame surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed aluminum frames in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed aluminum frames unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed aluminum frames as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 13 13 – STANDARD HOLLOW METAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal doors.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.
3. Section 08 81 00 for safety-rated glass.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. BMT: Base Metal Thickness.
2. DHI: Door Hardware Institute.
3. HM: Hollow Metal.
4. MSG: Manufacturer's Standard Gage.
5. SDI: Steel Door Institute.

B. Definitions:

1. Manufacturer: Means the door manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with door manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
3. Coordinate door hardware finishes with other door hardware finishes.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, undercuts, and finishes. Use the same reference numbers for openings and details as the Drawings.
 - 3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to door schedule.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished doors.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Doors must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Fire-Protection Rating: Within fire-resistance rated assemblies, provide fire-protection-rated doors conforming to NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 252, *"Standard Methods of Fire Tests of Door Assemblies"* and UL 10B, *"Standard for Fire Tests of Door Assemblies"*; or UL 10C, *"Standard for Positive Pressure Fire Tests of Door Assemblies"* for doors at atmospheric (neutral) pressure. A label or listing mark indicating the fire-protection rating must be permanently affixed at the factory in a location such that the label remains visible after the door is installed and must include UL "S" and "Positive Pressure Test" listings.
2. Temperature Rise Rating: At vertical exit enclosures and exit passageways, provide doors with a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
3. Smoke-Control Door Assemblies: Provide doors conforming to the requirements of with NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 105, *"Standard for Smoke Door Assemblies and Other Opening Protectives"* or UL 1784, *"Standard for Air Leakage Tests of Door Assemblies"*.

C. Quality Standard Requirements:

1. Manufacturing Tolerances: Comply with the requirements of ANSI/SDI publication ANSI/SDI A250.8, *"Recommended Specifications for Standard Steel Doors and Frames"*.
2. Hardware Preparations and Reinforcement: Comply with the requirements of ANSI/SDI A250.6, *"Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames"* with reinforcing plates fabricated from the same material as door face sheets.
3. Door Hardware Installation Standards: Install door hardware in conformance with ANSI/DHI A115-IG, *"Installation Guide for Doors and Hardware"*.

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing doors installed on at least 200 previous projects similar to this project in size, material, design, and complexity. Manufacturer must be a current member of SDI.

2. Installer: Company or individuals must have at least 5 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity. Installer must be a current member of SDI.
3. Supervisors: Individuals must have at least 7 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading door installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped, upright, and indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
- C. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.

- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Allegion PLC.

2. ASSA ABLOY.
3. Door Components, Inc.
4. MPI Custom Steel Doors and Frames.
5. Republic Doors and Frames.

2.3 STANDARD HOLLOW METAL DOORS

- A. Description: Commercial full flush and seamless steel-stiffened doors.
- B. Products: "Steelcraft" doors manufactured by Allegion, or equal.
 1. Standard Duty Doors: "SL20" doors, or equal.
 2. Heavy Duty Doors: "BW18" doors, or equal.
 3. Extra Heavy Duty Doors: "BW16" doors, or equal.
 4. Maximum Duty Doors: "BW14" doors, or equal.
 5. Temperature Rise Rated Doors: "T-14" doors, or equal.
- C. Requisite Properties:
 1. Construction: Provide the following, conforming to SDI 108.
 - a. Mechanical, Storage, and Utility Doors: Level 3 (extra heavy-duty), Model 2 (seamless with welded edge construction).
 2. Types: SDI 106, Type F (flush), as indicated on the Drawings.
 3. Thickness: 1-3/4 inches.
 4. Face Sheets:
 - a. Exterior Doors: Fabricate from at least 0.0747-inch BMT (MSG 14) galvanized steel sheet. (maximum duty)
 - b. Interior Doors at Wet Locations, including Shower and Toilet Rooms: Fabricate from at least 0.0747-inch BMT (MSG 14) galvanized steel sheet. (maximum duty)
 - c. Interior Doors Located Elsewhere: Fabricate from at least 0.0598-inch BMT (MSG 16) CRS. (extra heavy duty)
 - d. Level 3 (extra heavy-duty): 0.0598-inch BMT (MSG 16)
 5. Core Construction:
 - a. Exterior Insulated Doors: Maximum thermal transmittance (U-factor) value of not more than 0.50 BTU per hour per square foot per deg. F, when tested in conformance with ASTM C 1363.
 - b. Fire-Resistance Rated and Other Doors: Manufacturer's standard core necessary to meet indicated fire-resistance and temperature-rise ratings.
 6. Vertical Edges: Manufacturer's standard edge with mechanical edge seam welded and finished before priming.
 7. Top and Bottom Edges: Close edges with flush or inverted channels or end closures fabricated from same material as face sheets, but not less than at least 0.0747-inch BMT (MSG 14). Provide screw-on caps at exterior doors.

8. Minimum Hardware Reinforcement: Fabricate reinforcing from the same material as door in conformance with the following. Reinforcement must be offset to allow faces of mortised hardware devices to be installed flush with door surfaces.
 - a. Hinges: At least 0.1094-inch BMT (MSG 12) continuous stile extruded and tapped to at least 0.1875-inch BMT (MSG 07) reinforcement, unless another thickness and size are required by the by the hardware manufacturer based on actual in-service conditions applicable to the project.
 - b. Lock Front, Strike, and Flushbolt Reinforcement: At least 0.1094-inch BMT (MSG 12) by sizes required by the hardware manufacturer, unless another thickness is required by the by the hardware manufacturer based on actual in-service conditions applicable to the project.
 - c. Lock Reinforcement: At least 0.0625-inch BMT (MSG 16) by size as required by lock manufacturer, unless another thickness is required by the by the hardware manufacturer based on actual in-service conditions applicable to the project.
 - d. Closer Reinforcement: At least 0.0625-inch BMT (MSG 16) one-piece channel by size as required by the closer manufacturer, unless another thickness is required by the by the hardware manufacturer based on actual in-service conditions applicable to the project.
 - e. Exit Device Reinforcement: 0.0781-inch BMT (MSG 14) by 18 inches high by 3-3/16 inches wide, unless another thickness and size are required by the by the hardware manufacturer based on actual in-service conditions applicable to the project.
 - f. Other Hardware Reinforcement: Supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
 - g. Hardware manufacturers' recommended reinforcement units may be used in lieu of specified reinforcement.
9. Electrical Device Requirements: Make provisions for installation of electrified hardware and door electrical devices, and arrange so that wiring is readily installed, removed, and replaced.
 - a. Provide cutouts and reinforcement required for installation of devices.
 - b. Provide metal conduits or raceways to accommodate wiring between devices. (e.g., from electric hinge to other electric door hardware)

2.4 ACCESSORIES

- A. Filler: Material conforming to the requirements of SDI publication SDI 100, *"Specifications for Standard Steel Doors and Frames"*. Use UL-listed materials in doors scheduled to have a fire-resistance rating.
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 MATERIALS

- A. Uncoated Carbon Steel Sheet:
 - 1. Door Material: Finished CRS coil, sheet, and strip conforming to ASTM A 1008, CS Type B (commercial steel), exposed, temper rolled, regular matte surface finish (40 to 59 AA), and oiled (sheet must be thoroughly cleaned to remove the oil prior to painting).
 - 2. Hardware Reinforcements: HRS coil, sheet, and strip conforming to ASTM A 1011, CS Type B (commercial steel), as-rolled surface finish, with cut edges.
- B. Zinc-Iron Alloy Coated (Galvannealed) Steel Sheet: ASTM A 653, CS Type B (commercial steel), with equal coating weight on each surface.
 - 1. Coating Designation: Provide at least a A60 (galvannealed) minimum coating designation.
 - 2. Surface Finish: Non-spangled matte finish.
 - 3. Surface Treatment: Provide mill phosphate surface treatment. (provides enhanced lubricating characteristics)

2.6 FINISHES

- A. Uncoated Steel HM Frames: Provide shop-applied phosphate (paint-grip) pre-treatment and baked on rust inhibitive primer to all 6 door surfaces. Primer must be compatible with either field-applied paint or field-applied coating systems specified in Division 09, as applicable.
- B. Zinc Coated and Zinc-Iron Alloy Coated Steel and Stainless Steel HM Frames: Provide shop-applied bonderized pre-treatment. (not prime painted)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install doors in conformance with the quality standards publications using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
4. Installed doors must be warrantable. Do not install, correct, or replace doors in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach doors to supporting construction.

C. Installation Tolerances:

1. Fire-Rated Doors: Install doors with clearances in conforming to NFPA 80.
2. Smoke- Control Doors: Install doors with clearances in conforming to NFPA 105.
3. Other Doors: Install doors within the following clearance variations.
 - a. Jamb and Head: 1/8-inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 1/4-inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.

3.3 ADJUSTING

- A. Verify smooth and quiet door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible door surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed doors in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed doors unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed doors as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood veneer-faced flush wood doors.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.
3. Section 08 81 00 for safety-rated glass.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. DHI: Door Hardware Institute.
2. WDMA: Wood Door Manufacturers Association.

B. Definitions:

1. Manufacturer: Means the door manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with door manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
3. Coordinate door hardware finishes with other door hardware finishes.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:

- a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, undercuts, and finishes. Use the same reference numbers for openings and details as the Drawings.
 3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to door schedule.
 4. Samples: Submit at least 8-inch square representative samples of each door color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished doors.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals:
1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for door maintenance, cleaning, and repair to the Architect as a condition of project closeout.
 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Doors must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Fire-Protection Rating: Within fire-resistance rated assemblies, provide fire-protection-rated doors conforming to NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 252, *"Standard Methods of Fire Tests of Door Assemblies"* and UL 10B, *"Standard for Fire Tests of Door Assemblies"*; or UL 10C, *"Standard for Positive Pressure Fire Tests of Door Assemblies"* for doors at atmospheric (neutral) pressure. A label or listing mark indicating the fire-protection rating must be permanently affixed at the factory in a location such that the label remains visible after the door is installed and must include UL "S" and "Positive Pressure Test" listings.
2. Smoke-Control Door Assemblies: Provide doors conforming to the requirements of with NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 105, *"Standard for Smoke Door Assemblies and Other Opening Protectives"* or UL 1784, *"Standard for Air Leakage Tests of Door Assemblies"*.

C. Quality Standard Requirements:

1. Product Standard: Comply with the requirements Window & Door Manufacturers Association publication ANSI/WDMA I.S.1-A, *"Industry Standard for Interior Architectural Wood Flush Doors"*.
2. Door Hardware Installation Standards: Install door hardware in conformance with ANSI/DHI A115-IG, *"Installation Guide for Doors and Hardware"*.

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing doors installed on at least 200 previous projects similar to this project in size, material, design, and complexity. Manufacturer must be a current member of WDMA.
2. Installer: Company or individuals must have at least 5 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading door installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective doors with undamaged new doors that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. FSC Certified Wood or Equivalent:
 - a. For wood products in this section certified by the Forest Stewardship Council for responsible forest management according to FSC STD-01-00 and FSC STD-40-004, or equivalent, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to FSC 100% or FSC Pure labeled products over FSC Mix and FSC Mix labeled products.
 - 2. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Algoma Hardwoods, Inc.
 - 2. Eggers Industries.
 - 3. Marshfield DoorSystems, Inc.
 - 4. Oshkosh Architectural Door Co.
 - 5. VT Industries.

2.3 WOOD VENEER-FACED DOORS

- A. Description: Flush wood doors conforming to WDMA I.S.1-A Performance Grade Heavy Duty.
- B. Application: Transparent finish wood doors.
- C. Restrictions: Doors manufactured with adhesives and composite wood products containing urea formaldehyde are prohibited.
- D. Product: "Heritage Series" doors manufactured by VT Industries, or equal.
- E. Requisite Properties:
 - 1. Type: Solid Core.
 - 2. Grade: Premium.
 - 3. Thickness: 1-3/4 inches.
 - 4. Construction: 5-ply.
 - 5. Core: Manufacturer's standard wood-based particleboard, structural composite lumber, or fire-resistant composite or mineral core, or specialty core.
 - 6. Edge Construction: Structural composite lumber or hardwood lumber stiles and rails securely bonded to core components and machine calibrated before veneering, with edge banding veneer matching face veneer species and grade.
 - 7. Meeting Edge: Beveled at lock stile, square edged at strike stiles.
 - 8. Hardware Blocking: As required by hardware manufacturer to eliminate through-bolting hardware.
 - a. 5-by-18-inch lock blocks at both stiles.
 - b. 5-inch top rail blocking for closers and 5-inch bottom rail blocking where automatic door bottoms are indicated.
 - c. 2-1/2-inch mid-rail blocking.
 - 9. Exposed Vertical Surfaces: "White Maple Ravine RA18".
 - 10. Transparent Finish:
 - a. Grade: Premium.
 - b. Surface Finish: Clear conversion varnish.
 - c. Sheen: Satin.
 - 11. Horizontal Surfaces: Structural composite lumber.
 - 12. Openings: Cut and trim openings through doors in factory.
 - a. Light Openings: Trim openings with materials and profiles indicated.
 - b. Glazing: Field install glazing.
 - c. Louvers: Factory install louvers in prepared openings.

2.4 ACCESSORIES

- A. Vision Lights: "Vision Lite Kits" manufactured by TRUDOOR, LLC, or equal.
 - 1. Finish: Match door species.

2. Frame Color: Match door species.
 3. Safety-Rated Glass: Fully-tempered or laminated clear glass specified in Section 08 81 00.
- B. Electrical Device Requirements: Make provisions for installation of electrified hardware and door electrical devices, and arrange so that wiring is readily installed, removed, and replaced.
1. Provide cutouts and reinforcement required for installation of devices.
 2. Provide metal conduits or raceways to accommodate wiring between devices. (e.g., from electric hinge to other electric door hardware)
- C. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
1. Install doors in conformance with the quality standards publications using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
4. Installed doors must be warrantable. Do not install, correct, or replace doors in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Factory-Fitted Doors: Align in frames for uniform clearance at each edge. Hang doors to operate freely for their entire travel, but not loosely, without sticking or hinge binding, with hardware adjusted and functioning properly.
2. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach doors to supporting construction.

D. Installation Tolerances:

1. Fire-Rated Doors: Install doors with clearances in conforming to NFPA 80.
2. Smoke- Control Doors: Install doors with clearances in conforming to NFPA 105.
3. Other Doors: Install doors within the following clearance variations.
 - a. Jamb and Head: 1/8-inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 1/4-inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.

3.3 ADJUSTING

- A. Verify smooth and quiet door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Rehang or replace doors that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible door surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed doors in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed doors unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed doors as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 14 33 – STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stile and rail wood doors.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. DHI: Door Hardware Institute.
2. WDMA: Wood Door Manufacturers Association.

B. Definitions:

1. Manufacturer: Means the door manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with door manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
3. Coordinate door hardware finishes with other door hardware finishes.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets

- (SDSs), both of which are returned to the Contractor without review or responsive action.
- b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, undercuts, and finishes. Use the same reference numbers for openings and details as the Drawings.
 3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to door schedule.
 4. Samples: Submit at least 8-inch square representative samples of each door color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished doors.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals:
1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for door maintenance, cleaning, and repair to the Architect as a condition of project closeout.
 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
1. Doors must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.

- b. Items provided for each different installation must be obtained from the same source and manufacturer.
- 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

- 1. Fire-Protection Rating: Within fire-resistance rated assemblies, provide fire-protection-rated doors conforming to NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 252, *"Standard Methods of Fire Tests of Door Assemblies"* and UL 10B, *"Standard for Fire Tests of Door Assemblies"*; or UL 10C, *"Standard for Positive Pressure Fire Tests of Door Assemblies"* for doors at atmospheric (neutral) pressure. A label or listing mark indicating the fire-protection rating must be permanently affixed at the factory in a location such that the label remains visible after the door is installed and must include UL "S" and "Positive Pressure Test" listings.
- 2. Smoke-Control Door Assemblies: Provide doors conforming to the requirements of with NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"* and tested in conformance with NFPA 105, *"Standard for Smoke Door Assemblies and Other Opening Protectives"* or UL 1784, *"Standard for Air Leakage Tests of Door Assemblies"*.

C. Quality Standard Requirements:

- 1. Product Standard: Comply with the requirements Window & Door Manufacturers Association publication ANSI/WDMA I.S.1-A, *"Industry Standard for Interior Architectural Wood Flush Doors"*.
- 2. Door Hardware Installation Standards: Install door hardware in conformance with ANSI/DHI A115-IG, *"Installation Guide for Doors and Hardware"*.

D. Qualifications:

- 1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing doors installed on at least 200 previous projects similar to this project in size, material, design, and complexity. Manufacturer must be a current member of WDMA.
- 2. Installer: Company or individuals must have at least 5 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity.
- 3. Supervisors: Individuals must have at least 7 years' experience installing doors for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading door installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.

2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective [door]s with undamaged new [door]s that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Algoma Hardwoods, Inc.
 2. Eggers Industries.
 3. Oshkosh Architectural Door Co.
 4. Rustica Doors.

2.2 STILE AND RAIL WOOD DOORS

- A. Description: Wood doors conforming to WDMA I.S.1-A Performance Grade Heavy Duty.

- B. Restrictions: Doors manufactured with adhesives and composite wood products containing urea formaldehyde are prohibited.
- C. Product: "Z Outdoor Rated Barn Doors" manufactured by Rustica Doors, or equal.
- D. Requisite Properties:
 - 1. Size: 2-feet by 4-feet.
 - 2. Minimum Stile and Top Rails: At least a 5-1/2-inch face dimension.
 - 3. Minimum Cross Rails and Mullions: At least a 4-inch face.
 - 4. Minimum Bottom Rails: At least a 9-inch face dimension.
 - 5. Meeting Edge: Beveled at lock stile, square edged at strike stiles.
 - 6. Hardware Blocking: As required by hardware manufacturer to eliminate through-bolting hardware.
 - 7. Exposed Vertical Surfaces: Wood veneer.
 - a. Veneer Grade:
 - b. Face Cut and Veneer Species:
 - c. Grain Direction:
 - d. Veneer Match:
 - 8. Transparent Finish:
 - a. Grade: Premium.
 - b. Surface Finish: Clear conversion varnish.
 - c. Stain: Indicated on the Drawings or selected by the Architect.
 - d. Sheen: Indicated on the Drawings or selected by the Architect.
 - 9. Horizontal Surfaces: Structural composite lumber.

2.3 ACCESSORIES

- A. Electrical Device Requirements: Make provisions for installation of electrified hardware and door electrical devices, and arrange so that wiring is readily installed, removed, and replaced.
 - 1. Provide cutouts and reinforcement required for installation of devices.
 - 2. Provide metal conduits or raceways to accommodate wiring between devices. (e.g., from electric hinge to other electric door hardware)
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install doors in conformance with the quality standards publications using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 - 4. Installed doors must be warrantable. Do not install, correct, or replace doors in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. Factory-Fitted Doors: Align in frames for uniform clearance at each edge. Hang doors to operate freely for their entire travel, but not loosely, without sticking or hinge binding, with hardware adjusted and functioning properly.
 - 2. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach doors to supporting construction.
- D. Installation Tolerances:
 - 1. Fire-Rated Doors: Install doors with clearances in conforming to NFPA 80.

2. Smoke- Control Doors: Install doors with clearances in conforming to NFPA 105.
3. Other Doors: Install doors within the following clearance variations.
 - a. Jamb and Head: 1/8-inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 1/4-inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.

3.3 ADJUSTING

- A. Verify smooth and quiet door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Rehang or replace doors that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible door surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.

2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed doors in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed doors unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed doors as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 17 00 – INTEGRATED DOOR ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Integrated door assemblies.
 - 2. Manufacturer's hardware.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - 2. Section 08 71 00 for door hardware.

1.2 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. DHI: Door Hardware Institute.
 - 2. SDI: Steel Door Institute.
- B. Definitions:
 - 1. Manufacturer: Means the integrated door manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate building opening tolerances with integrated door manufacturing and erection tolerances.
 - 2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
 - 3. Coordinate integrated door hardware finishes with other door hardware finishes.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract

- Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Door Schedule: Submit schedule showing opening identification symbols and integrated door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, and undercuts. Use the same reference numbers for openings and details as the Drawings.
 3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to door schedule.
 4. Samples: Submit at least 8-inch square representative samples of each integrated door color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished integrated doors.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals:
1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for integrated door maintenance, cleaning, and repair to the Architect as a condition of project closeout.
 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
1. Integrated doors must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.

- b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
 - B. Quality Standard Requirements:
 1. Manufacturing Tolerances: Comply with the requirements of ANSI/SDI publication ANSI/SDI A250.8, *"Recommended Specifications for Standard Steel Doors and Frames"*.
 2. Door Frame Installation Standards:
 - a. Install fire-resistance rated frames in conformance with NFPA 80, *"Standard for Fire Doors and Other Opening Protectives"*.
 - b. Install other frames in conformance with of ANSI A250.11, *"Recommended Erection Instructions for Steel Frames"*.
 3. Hardware Preparations and Reinforcement: Comply with the requirements of ANSI/SDI A250.6, *"Recommended Practice for Hardware Reinforcing on Standard Steel Integrated doors and Frames"* with reinforcing plates fabricated from the same material as integrated door face sheets.
 4. Door Hardware Installation Standards: Install integrated door hardware in conformance with ANSI/DHI A115-IG, *"Installation Guide for Doors and Hardware"*.
 - C. Qualifications:
 1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing integrated doors installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
 2. Installer: Company or individuals must have at least 5 years' experience installing integrated doors for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing integrated doors for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading integrated door installers.
- 1.6 HANDLING
- A. Receiving and Inspection: Inspect all deliveries for deteriorated, damaged, and defective items. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open containers.
 - B. Unloading: With minimum handling, unload and store only inspected and accepted items.
 - C. Storage: Store unloaded items as shipped, upright, and indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.

- D. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Adams Rite Manufacturing Co.
 - 2. Total Door Systems.
 - 3. Allegion IMPACT Doors.

2.2 INTEGRATED DOOR ASSEMBLIES

- A. Products: "RITE Door" manufactured by Adams Rite Manufacturing Co., or equal.
- B. Requisite Properties:
 - 1. Model: Selected by the Architect, or equal.
 - 2. Sizes and Fire Ratings: Indicated on the Drawings.
 - 3. Door Construction: Manufacturer's standard integrated assembly system construction; 1-3/4-inch thick, with no visible seams or spot welds on door faces.
 - 4. Frames: Fabricate from at least 0.0598-inch BMT (MSG 16) CRS. Furnish frames with mitered corners, continuously welded and ground smooth on frame face. Prepare frames with 0.0747-inch BMT (MSG 14) reinforcements for applied hardware and minimum 4 each adjustable-type anchors per jamb for wall conditions.
 - 5. Fire Rated Doors and Frames: Fabricate in conformance with NFPA 80, listed and labeled by a qualified testing agency, for the fire protection ratings indicated.
 - 6. Finish: Selected by the Architect.
 - 7. Recessed panic hardware.
- C. Performance Requirements
 - 1. Steel Doors: ANSI/SDI A250.8, Grade 1, and at least 5,000,000 cycles.
 - 2. Exit Devices: ANSI/BHMA A156.3, Grade 1, and at least 5,000,000 cycles.

3. Closers: ANSI/BHMA A156.4, Grade 1.
4. Mortise Locks/Latches: ANSI/ BHMA A156.13, Grade 1, and at least 5,000,000 cycles.
5. Full-Height Hinges: ANSI/ BHMA A156.26, Grade 1, and at least 5,000,000 cycles.
6. Warnock Hershey Category D (Integrated Door/Frame Assemblies)
7. California State Fire Marshal Listed.

2.3 MANUFACTURER'S HARDWARE

- A. Description: Provide complete integrated door opening assembly, including installation and adjustment of all hardware, latching mechanisms within the door construction, thresholds, and weatherstripping.
- B. Hardware: Manufacturer's standard factory-installed operating hardware; finish to match adjacent door hardware.

2.4 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce framing members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install integrated doors in conformance with the quality standards publications using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed integrated doors must be warrantable. Do not install, correct, or replace integrated doors in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach integrated doors to supporting construction.

C. Integrated door Installation Tolerances:

1. Fire-Rated Integrated Doors: Install integrated doors with clearances in conforming to NFPA 80.
2. Smoke-Control Integrated Doors: Install integrated doors with clearances in conforming to NFPA 105.
3. Other Integrated Doors: Install integrated doors within the following clearance variations.
 - a. Jambs and Head: 1/8-inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Integrated doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between Bottom of Integrated door and Top of Threshold: Maximum 1/4-inch.
 - d. Between Bottom of Integrated door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.

D. Frame Installation Tolerances: Install frames within the following tolerance variations.

1. Maximum Out of Square: Not more than 1/16-inch, measured at rabbet on 90 degrees from jamb perpendicular to frame head.
2. Maximum Out of Alignment: Not more than 1/16-inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Maximum Twist: Not more than 1/16-inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Maximum Out of Plumb: Not more than 1/16-inch, measured on floor at jambs.

3.3 ADJUSTING

- A. Verify smooth and quiet integrated door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible integrated door surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed integrated doors in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed integrated doors unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed integrated doors as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 31 16 – ACCESS PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal access panel assemblies.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. BMT: Base Metal Thickness.
- B. Definitions:
 - 1. Manufacturer: Means the access panel manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate locations of items and equipment being accessed with access panel sizes and locations indicated on the Drawings.
 - 2. Coordinate hardware preparations, handing, reinforcement requirements, and locations with the Drawings, access panel manufacturer, and selected hardware sets.
- B. Acoustical Requirements:
 - 1. Provide fire-rated access doors with continuous piano-style hinges at sound-rated construction.
 - 2. Seal door flange perimeter with “S88” adhesive-backed fire and smoke gasketing manufactured by Pemko Manufacturing Co., Inc., or equal.
 - 3. Seal entire assembly to gypsum board with acoustical sealant.
 - 4. Include 1-1/2-inch-thick minimum insulation laminated with at least 2 pound per square foot density material such as gypsum board.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs) both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing access panel locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished access panels.
 - 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:

1. Access panels must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective access panels with undamaged new access panels that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 METAL ACCESS PANEL AND FRAMES

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Activar Construction Products Group, Inc.
 - 2. Acudor Products, Inc.
 - 3. Karp Associates, Inc.
 - 4. Nystrom Building Products.
- B. Non-Rated Access Panels at Ceramic Tile Wall Finishes:
 - 1. Description: Flush stainless steel access panels and frames.
 - 2. Product: "JL Industries Model TMS" manufactured by Activar Construction Products Group, Inc., or equal.
 - 3. Material: Type 304, 0.0625-inch BMT (USSG 16) stainless steel frame with at least 0.0625-inch BMT (USSG 16) stainless steel door.
 - 4. Trim: At least 0.0312-inch BMT (USSG 22) stainless steel flange.
 - 5. Hinge: Concealed continuous piano hinge.
- C. Non-Rated Access Panels Elsewhere:
 - 1. Description: Flush concealed frame access panels with wallboard bead.
 - 2. Product: "JL Industries Model TMW" manufactured by Activar Construction Products Group, Inc., or equal.
 - 3. Material: At least 0.0598-inch BMT (MSG 16) cold-rolled uncoated steel sheet frame and 0.0598-inch BMT (MSG 16) cold-rolled uncoated steel sheet door.
 - 4. Trim: At least 0.0299-inch BMT (MSG 22) HDG steel sheet gypsum board tape-in bead flange.
 - 5. Hinge: Concealed continuous piano hinge.
 - 6. Finish: Manufacturer's standard shop-applied phosphate pre-treatment and baked on rust inhibitive primer for field-applied finish.
- D. Fire-Resistance Rated Access Panels:
 - 1. Description: Fire-rated and insulated concealed frame access panel with wallboard bead.
 - 2. Product: "JL Industries Model FDW" manufactured by Activar Construction Products Group, Inc., or equal.
 - 3. Material: At least 0.0598-inch BMT (MSG 16) cold-rolled uncoated steel sheet frame with At least 0.0359-inch BMT (MSG 20) cold-rolled uncoated steel sheet door.
 - 4. Trim: At least 0.0299-inch BMT (MSG 22) HDG steel sheet gypsum board tape-in bead flange.
 - 5. Insulation: At least 2-inch thick fire-resistive mineral wool insulation sandwiched between access panel faces.
 - 6. Hinge: Concealed continuous piano hinge.
 - 7. Finish: Manufacturer's standard shop-applied phosphate pre-treatment and baked on rust inhibitive primer for field-applied finish.

E. Requisite Properties:

1. Provide at least 24-inch square or larger panel assemblies where servicemen must access spaces through panels.
2. Elsewhere, provide at least 12-inch square panel assemblies.

F. Accessories:

1. Locking Devices:

- a. Public Areas: Provide one mortise cylinder lock per access door. Key all locks alike, unless otherwise noted.
- b. Other Areas: Provide flush, key-operated cam lock. Key all locks alike, unless otherwise noted.
- c. Panels 24 inches or More in Any Dimension: Provide interior latch to permit access panel opening from inside without a key.

2. Gaskets: Apply manufacturer's optional gasketing to frames of units that do not come standard with gaskets.

3. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

4. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.

B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install access panels using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed access panels must be warrantable. Do not install, correct, or replace access panels in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach access panels to supporting construction.

C. Installation Tolerances: Install access panels to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 ADJUSTING

A. Verify smooth and quiet access panel door and hardware operation.

B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.

C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible access panel surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed access panels in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed access panels unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed access panels as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront assemblies.
2. Aluminum-framed glass entrance doors.
3. Site tests and inspections.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.
3. Section 08 81 00 for glass glazing.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AAMA: American Architectural Manufacturers Association.
2. WDMA: Window & Door Manufacturers Association.
3. CSA: Canadian Standards Association.

B. Definitions:

1. Manufacturer: Means the entrance door or storefront manufacturer, as the context admits, unless otherwise indicated.
2. Failure: Includes noise or vibration caused by movement, material deterioration beyond normal weathering, water leakage through fixed glazing and framing areas, and failure of operating components.
3. Water Leakage: Means no uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to the exterior.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with entrance door manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
3. Coordinate entrance door hardware finishes with other door hardware finishes.
4. Coordinate building opening tolerances with storefront manufacturing and erection tolerances. The manufacturer must accommodate building frame tolerances.

B. Performance Requirements:

1. General: Entrances and storefronts must establish and maintain a continuous watertight seal without failure.
2. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, *"Minimum Design Loads and Associated Criteria for Buildings and other Structures"*.
3. Superstructure Deflection and Story Drift: Accommodate design displacement of adjacent stories indicated on the structural drawings.
4. Seismic Loads: Resist, distribute, or transfer seismic loads indicated on the structural drawings without incipient or catastrophic failure.
5. Perpendicular Deflection (Convexity and Concavity):
 - a. Storefront Framing Spans up to 13 Feet 6 Inches: Framing members may not deflect more than $L/175$ or 3/4-inch, whichever is less, measured normal to the assembly plane.
 - b. Storefront Framing Spans between 13 Feet 6 Inches and 40 Feet: Framing members may not deflect more than $L/240$ plus 1/4-inch, measured normal to the assembly plane.
 - c. Deflection of the horizontal sill member due to the weight of the glass should not exceed 1/8-inch nor should the deflection decrease the head clearance of the panel below by more than 25 percent.
 - d. Storefront Spans Greater than 40 Feet: Provide structural analysis.
 - e. Cantilever Deflection: Not more than $2L/175$, where "L" is the cantilever length, measured normal to the assembly plane.
 - f. Center of Glass Deflection: Not more than $L/50$ of short side length, or one inch, whichever is less, measured normal to the assembly plane.
6. Parallel Deflection (Sagging): Limit deflection under maximum design load to either 1/8-inch or not more than 25-percent reduction in glass bite, whichever is smaller measured in line with the assembly plane.
 - a. Minimum Clearance Between Framing Members and Top of Glazing or other Fixed Component Immediately Below: 1/8-inch.
 - b. Minimum Clearance Between Framing Members and Operable Components, Including Doors and Entrances: 1/16-inch.
 - c. Maximum Twisting of Doors and Entrances: Twisting (rotation) of horizontal framing members caused by glass weight may not exceed one degree, measured between the ends and the center of each span.

7. Permanent Deformation: No permanent deformation at design pressure. Limit permanent deformation to 0.2 percent of the clear span of any framing member, when tested in conformance with ASTM E 330 (uniform static pressure test).
 - a. Maximum Positive and Negative Test Loads: Equal to at least the specified design pressure.
 - b. Maximum Positive and Negative Proof Loads for Vertical Glazing: At least equal to 1.5 times the design pressure.
 - c. Maximum Positive and Negative Proof Loads for Sloped Glazed Assemblies: At least equal to 2.0 times the design pressure.
 - d. Duration of Maximum Test and Proof Loads: 10 seconds.
 - e. Measurement: The number and location of deflection measurements must be shown on the mockup shop drawings prior to testing. At a minimum, indicate measurement of deflection at maximum deflection and end deflection locations
8. Thermal Transmittance (U-Factor): Maximum assembly thermal transmittance value may not exceed the following.
 - a. Maximum Winter Nighttime Transmittance (U-value): Not more than 0.36 for fixed assemblies; and 0.46 BTU per hour per square foot per deg. F. for operable assemblies.
 - b. Maximum Summer Daytime Transmittance (U-value): Not more than 0.42 BTU per hour per square foot per deg. F.
9. Air Leakage (AL): Maximum permanent AL rating of not more than 0.06 cubic feet per minute per square foot, when tested in conformance with ASTM E 283 at 6.24 pounds per square foot minimum differential static air pressure.
10. Water Leakage: No water leakage through the assembly or joints, when tested in conformance with both ASTM E 331 (uniform static air pressure test) and AAMA 501 (dynamic pressure test) at 12 pounds per square foot minimum differential pressure.
11. Condensation Resistance Factor (CRF): Minimum CRF value of at least the following, when tested in conformance with NFRC 500.
 - a. Combined Framing Members and Glazing: At least 56.
 - b. Framing Members Only: At least 70.
12. Sound Transmission Class (STC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested STC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
13. Outdoor-Indoor Transmission Class (OITC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested OITC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
14. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
15. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified in Section 05 50 00.

C. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed entrances and storefronts. Resolve each condition.
4. Identify and discuss site tests and inspections, including test procedures, methods, differential pressures, sequencing, measurement, results, acceptance criteria, remedial work, recording and distributing results, and other topics necessary to carrying out required site tests and inspections.
5. Identify and discuss equipment, tools, facilities, personnel, and controls necessary for each site test and inspection.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
2. Door Schedule: Submit schedule showing opening identification symbols and entrance door types and sizes, including thickness, swing, fire-resistance rating label requirements, and undercuts. Use the same reference numbers for openings and details as the Drawings.
3. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing entrance door and storefront layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific

to the project. Cross-reference entrance door details to door schedule. Cross-reference storefront details to plans and elevations.

4. Samples:
 - a. Submit at least 6-inch square representative samples of each entrance door and storefront framing color and finish.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished entrance doors and storefronts.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for entrance door maintenance, cleaning, and repair.
 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Entrance doors and storefronts must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Automatic and power-assisted doors must conform to the requirements of California Building Code Section 11B-404.3

C. Quality Standard Requirements:

1. Entrance Door Product Standard: Comply with the requirements of ANSI/AAMA/WDMA publication ANSI/AAMA/WDMA 101/I.S.2/NAFS-02, "*Windows, Skylights and Glass Doors*".
2. Entrance Door Performance Standard: Comply with the requirements of AAMA/WDMA/CSA publication AAMA/WDMA/CSA 101/I.S.2/A440, "*NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights*".

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing entrance doors and storefronts installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Installer: Company or individuals must have at least 5 years' experience installing entrance doors and storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity.
3. Supervisors: Individuals must have at least 7 years' experience installing entrance doors and storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading entrance and storefront installers.
4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

E. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate entrance doors and storefronts into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
 - 1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 - 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective entrances or storefront materials with undamaged new items or materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years; and for finishes against color fading, chalking, cracking, checking, peeling, and adhesive failure for 20 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.

5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.

- 1) Refer to Section 018113 for VOC content limits
- 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

A. Manufacturer: Provide products manufactured by one of the following, or equal.

1. Arcadia.
2. Kawneer Co., Inc.
3. Wausau Window and Wall Systems.

2.3 ALUMINUM-FRAMED STOREFRONTS

A. Description: Thermally broken storefront framing.

B. Products: Provide one of the following, or equal.

1. "TC670 Series" manufactured by Arcadia.
2. "Trifab VersaGlaze 451T Framing System" manufactured by Kawneer Co., Inc.
3. "1400 Thermal" manufactured by Wausau Window and Wall Systems.

C. Requisite Properties:

1. Framing Size: 2-1/4 inches by 6 inches.
2. Glazing Thickness: One-inch.
3. Glazing Installation: Outside glazed.
4. Exposed Finishes: "Arcadia AB-7, Standard Dark Bronze".
5. Concealed Steel Finishes: Prepare surfaces and apply shop primer.

6. Concealed Aluminum Finishes: Prepare surfaces and coat aluminum surfaces in contact with masonry, concrete, or steel with bituminous paint specified Section 05 50 00.

2.4 MEDIUM-STILE ENTRANCES

- A. Description: Thermally broken medium stile entrance doors.
- B. Products: Provide one of the following, or equal.
 1. "MS362T Series" manufactured by Arcadia.
 2. "350T" manufactured by Kawneer Co., Inc.
 3. "Thermal Block Entrances" manufactured by Wausau Window and Wall Systems.
- C. Requisite Properties:
 1. Entrance Door Thickness: 1-3/4 inches.
 2. Vertical Stile Width: 5-inches.
 3. Top Rail Width: 5-inches.
 4. Bottom Rail Width: 10 inches.
 5. Glazing Thickness: One-inch.
 6. Glazing Stops: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide non-removable glazing stops on outside of door.
 7. Exposed Finishes: "Arcadia AB-7, Standard Dark Bronze".

2.5 WIDE-STILE ENTRANCES

- A. Products: Provide one of the following, or equal.
 1. "WS512 Series" manufactured by Arcadia.
 2. "500 Wide Stile Entrance" manufactured by Kawneer.
 3. "Wide Stile Standard Entrances" manufactured by Wausau Window and Wall Systems.
- B. Requisite Properties:
 1. Entrance Door Thickness: 1-3/4 inches.
 2. Vertical Stile Width: 5 inches.
 3. Top Rail Width: 5 inches.
 4. Bottom Rail Width: 10 inches.
 5. Glazing Thickness: One-inch.
 6. Glazing Stops: Square, snap-on, extruded-aluminum stops and preformed gaskets. Provide non-removable glazing stops on outside of door.
 7. Exposed Finishes: Match storefront framing.

2.6 MATERIALS

A. Aluminum:

1. Standard Aluminum Structural Profiles: ASTM B 308, Alloy 6061-T6.
2. Extruded Aluminum Bars and Shapes: ASTM B 221, Alloy 6063-T5 or T6 for primary components; Alloy 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
3. Aluminum Sheet and Plate: ASTM B 209, Alloy 5005-H32 or Alloy 3003-H14.
4. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.
5. Structural Aluminum Pipe and Round Tube: ASTM B 429.

B. Glazing: Specified in Section 08 81 00.

2.7 ACCESSORIES

- A. Steel Reinforcement: When required by engineering calculations, provide steel bent plate or shapes conforming to ASTM A 36 and shop primed.
- B. Brackets: Provide high-strength aluminum or austenitic stainless steel brackets and reinforcements.
- C. Sill Flashing: Fabricate from at least 0.060-inch thick aluminum sheet, with welded end dams and finished to match frames.
- D. Concealed Flashing: Stainless steel sheet conforming to ASTM A 240 (annealed) Type 04 (for all other applications), No. 2D (matte) finish, annealed, No. 4 (soft) temper (hardness not more than Rockwell B-65; can be bent flat upon itself in any direction).
- E. Movement Joints: Slip-joint linings, slip pads, spacers, and sleeves of material and type supplied, required, recommended, approved, or accepted by the manufacturer.
- F. Glazing Gaskets: Manufacturer's standard ethylene propylene diene monomer (EPDM) conforming to ASTM C 864 and having a Shore A hardness value of at least 70, unless another type of gasket is supplied, required, recommended, or accepted by the manufacturer.
- G. Silicone Gutter Gaskets: Custom extrusions installed with low modulus single-component sealant specified in Section 07 92 00.
- H. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce framing members as required to receive fastener threads.
 3. Exposed fasteners are prohibited on faces exposed to view. Provide concealed fasteners and expansion provisions.

- I. Anchors:
 - 1. Anchor Bolts (Anchor Rods): Cast-in-place anchors having minimum 60 ksi tensile strength.
 - 2. Other Anchors:
 - a. Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by the manufacturer.
 - b. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements
- J. Cleaning Agent and Cloth: Supplied, required, recommended, or accepted by the structural sealant manufacturer.
- K. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install entrance doors and storefronts using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 4. Installed entrance doors and storefronts must be warrantable. Do not install, correct, or replace entrance doors and storefronts in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Use concealed fasteners and anchorages. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces and to make weathertight connections.
 2. Form closely-fitted joints with exposed connections accurately located and secured.
 3. Provide uniform-width perimeter reveals and opening sealants and joint fillers as indicated.
 4. Install concealed gaskets, flashings, and joint fillers as the storefront installation progresses.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach entrance doors and storefronts to supporting construction.
- D. Entrance Door Installation Tolerances: Install entrance doors within the following clearance variations.
- a. Jamb and Head: 1/8-inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8-inch plus or minus 1/16-inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 1/4-inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.
- E. Storefront Installation Tolerances: Install storefronts within the following tolerance variations.
1. Maximum Variation from True Position: Not more than 1/8-inch in 12 feet nor more than 1/4-inch over any total length.
 2. Maximum Variation from Plane: Not more than 1/8-inch in 12 feet nor more than 1/2-inch over any total length.
 3. Maximum Out of Plumb: Not more than 1/8-inch in 10 feet nor more than 1/4-inch in any 40-foot run.
 4. Maximum Out of Level: Not more than 1/8-inch in 20 feet nor more than 1/4-inch in any 40-foot run.
 5. Maximum Misalignment of Adjacent Members: 1/16-inch.
 6. Maximum Offset between Components at Joints:
 - a. In-line Surfaces: Not more than 1/16-inch, except that offset are not allowed at welded joints.

- b. Corners: Not more than 1/32-inch
- 7. Squareness: Not more than 1/8-inch difference in diagonal measurements.
- 8. Maximum Bow: Not more than 1/16-inch in any four foot framing length.

3.3 ADJUSTING

- A. Verify smooth and quiet entrance door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
 - 1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute them to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
 - 2. Required Tests:
 - a. Water Leakage Hose Tests: Perform water leakage hose tests in conformance with ASTM AAMA 501.2 (fixed glazing assemblies) and AAMA 502 (operable window units). At least 10 percent of installed aluminum framed entrances and storefront assemblies must be AAMA nozzle tested.
 - b. Air and Water Leakage Chamber Tests: Perform air and water leakage chamber tests in conformance with AAMA 502, Test method B. At least 2 testing sites for each assembly spanning 3 periods: Mockup, 10 percent complete, and 50 percent complete.

3. Testing Requirements:

- a. E1105 chamber test is only used for discrete window units having a maximum 8-foot by 8-foot test size. For areas larger than 8-feet by 8-feet, perform nozzle testing in conformance with AAMA 501.2, differential pressure testing.
- b. 2/3 reduction of laboratory air pressure for field testing pressure is permitted.
- c. If sill receptors are used, add in another test to occasionally test sill receptors and other horizontal cavities that may collect water by temporarily plugging weep holes and filling with water in conformance with AAMA 502, at least 15-minute test duration, and at least 3 additional locations. Remove weep hole plugs and drain system at conclusion of test. Perform tests at start of the work and periodically throughout the construction process (minimum once every two weeks of installation).
- d. For each failure condition discovered, make remedial and corrective action approved by the Owner and Architect, and complete similar detailing at all similar conditions and locations.
- e. Additional testing and inspecting shall be at Contractor's expense, and will be performed to determine compliance of replaced or additional work with specified requirements. Add one additional test location for each failure.
 - 1) If a testing specimen fails air testing, perform smoke tracer testing in ASTM E 1186.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 PROTECTION

- A. Protect installed entrance doors and storefronts in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed entrance doors and storefronts unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed entrance doors and storefronts as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 42 14 – INTERIOR ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum-framed entrance doors.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 71 00 for door hardware.
3. Section 08 81 00 for glass glazing.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the interior entrance door manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with entrance door manufacturing and erection tolerances.
2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
3. Coordinate entrance door hardware finishes with other door hardware finishes.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Door Schedule: Submit schedule showing opening identification symbols and entrance door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, and undercuts. Use the same reference numbers for openings and details as the Drawings.
 3. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference entrance door details to door schedule. Cross-reference entrance door details to plans and elevations.
 4. Samples:
 - a. Submit at least 8-inch long representative samples of each interior entrance door color, finish, and variety.
 - b. Submit representative samples of each entrance door hardware variety and finish.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Submit manufacturer-prepared published instructions for proper installation of furnished interior entrance doors.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Interior entrance doors must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective interior entrance doors with undamaged new interior entrance doors that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 INTERIOR ENTRANCE DOORS

- A. Products: "Alumaglide Sliding Glass Doors" manufactured by Western Integrated Materials, Inc., or equal.
- B. Requisite Properties:
 - 1. Thickness: Indicated on the Drawings or selected by the Architect.
 - 2. Framing Members: Indicated on the Drawings or selected by the Architect.
 - 3. Nominal Glass Thickness: 1/4-inch.
 - 4. Glazing Type: Clear Tempered.
 - 5. Finish: Manufacturer's standard clear anodized finish.

2.3 ACCESSORIES

- A. Minimum Hardware Reinforcement: Manufacturer's standard factory-installed operating hardware preparations.
- B. Glazing Gaskets: Manufacturer's standard ethylene propylene diene monomer (EPDM) conforming to ASTM C 864 and having a Shore A hardness value of at least 70, unless another type of gasket is supplied, required, recommended, or accepted by the manufacturer.
- C. Brackets: Provide high-strength aluminum or non-magnetic austenitic stainless steel brackets and reinforcements.
- D. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install interior entrance doors using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed interior entrance doors must be warrantable. Do not install, correct, or replace interior entrance doors in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. Use concealed fasteners and anchorages. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces.
 - 2. Form closely-fitted joints with exposed connections accurately located and secured.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach interior entrance doors to supporting construction.
- D. Installation Tolerances: Install entrance doors within the following clearance variations.
 - 1. Jambs and Head: 1/8-inch plus or minus 1/16 inch.
 - 2. Between Edges of Pairs of Doors: 1/8-inch plus or minus 1/16-inch.

3. Between Bottom of Door and Top of Threshold: Maximum 1/4-inch.
4. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 1/4-inch.

3.3 ADJUSTING

- A. Verify smooth and quiet operable entrance door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible interior entrance door surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.

4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
 - B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.
- 3.6 PROTECTION
- A. Protect installed interior entrance doors in place from soiling, deterioration, and damage until Substantial Completion.
 - B. Do not store anything on or adjacent to or against installed interior entrance doors unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed interior entrance doors as work surfaces.
 - C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 43 33 – SLIDING STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed sliding storefronts.
2. Delegated design of storefront assemblies.
3. Site tests and inspections.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 81 00 for glass glazing.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AAMA: American Architectural Manufacturers Association.
2. WDMA: Window & Door Manufacturers Association.
3. CSA: Canadian Standards Association.

B. Definitions:

1. Manufacturer: Means the sliding storefront manufacturer, as the context admits, unless otherwise indicated.
2. Failure: Includes noise or vibration caused by movement, material deterioration beyond normal weathering, water leakage through fixed glazing and framing areas, and failure of operating components.
3. Water Leakage: Means no uncontrolled water penetrating assemblies or water appearing on assemblies' normally-exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to the exterior.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with sliding storefront manufacturing and erection tolerances.

2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
 3. Coordinate entrance door hardware finishes with other door hardware finishes.
 4. Coordinate building opening tolerances with storefront manufacturing and erection tolerances. The manufacturer must accommodate building frame tolerances.
- B. Delegated Design Requirements:
1. Engineer, fabricate, assemble, and install sliding storefronts that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and result in structurally sound, non-corroding, and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
 2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.
- C. Performance Requirements:
1. General: Entrances and storefronts must establish and maintain a continuous watertight seal without failure.
 2. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, "*Minimum Design Loads and Associated Criteria for Buildings and other Structures*".
 3. Superstructure Deflection and Story Drift: Accommodate design displacement of adjacent stories indicated on the structural drawings.
 4. Seismic Loads: Resist, distribute, or transfer seismic loads indicated on the structural drawings without incipient or catastrophic failure.
 5. Perpendicular Deflection (Convexity and Concavity):
 - a. Storefront Framing Spans up to 13 Feet 6 Inches: Framing members may not deflect more than $L/175$ or 3/4-inch, whichever is less, measured normal to the assembly plane.
 - b. Storefront Framing Spans between 13 Feet 6 Inches and 40 Feet: Framing members may not deflect more than $L/240$ plus 1/4-inch, measured normal to the assembly plane.
 - c. Deflection of the horizontal sill member due to the weight of the glass should not exceed 1/8" nor should the deflection decrease the head clearance of the panel below by more than 25%.
 - d. Storefront Spans Greater than 40 Feet: Provide structural analysis.
 - e. Cantilever Deflection: Not more than $2L/175$, where "L" is the cantilever length, measured normal to the assembly plane.
 - f. Center of Glass Deflection: Not more than $L/50$ of short side length, or one inch, whichever is less, measured normal to the assembly plane.
 6. Parallel Deflection (Sagging): Limit deflection under maximum design load to either 1/8-inch or not more than 25-percent reduction in glass bite, whichever is smaller measured in line with the assembly plane.

- a. Minimum Clearance Between Framing Members and Top of Glazing or other Fixed Component Immediately Below: 1/8-inch.
 - b. Minimum Clearance Between Framing Members and Operable Components, Including Doors and Entrances: 1/16-inch.
 - c. Maximum Twisting of Doors and Entrances: Twisting (rotation) of horizontal framing members caused by glass weight may not exceed one degree, measured between the ends and the center of each span.
7. Permanent Deformation: No permanent deformation at design pressure. Limit permanent deformation to 0.2 percent of the clear span of any framing member, when tested in conformance with ASTM E 330 (uniform static pressure test).
- a. Maximum Positive and Negative Test Loads: Equal to at least the specified design pressure.
 - b. Maximum Positive and Negative Proof Loads for Vertical Glazing: At least equal to 1.5 times the design pressure.
 - c. Maximum Positive and Negative Proof Loads for Sloped Glazed Assemblies: At least equal to 2.0 times the design pressure.
 - d. Duration of Maximum Test and Proof Loads: 10 seconds.
 - e. Measurement: The number and location of deflection measurements must be shown on the mockup shop drawings prior to testing. At a minimum, indicate measurement of deflection at maximum deflection and end deflection locations
8. Thermal Transmittance (U-Factor): Maximum assembly thermal transmittance value may not exceed the following.
- a. Maximum Winter Nighttime Transmittance (U-value): Not more than 0.36 for fixed assemblies; and 0.46 BTU per hour per square foot per deg. F. for operable assemblies.
 - b. Maximum Summer Daytime Transmittance (U-value): Not more than 0.42 BTU per hour per square foot per deg. F.
9. Air Leakage (AL): Maximum permanent AL rating of not more than 0.06 cubic feet per minute per square foot, when tested in conformance with ASTM E 283 at 6.24 pounds per square foot minimum differential static air pressure.
10. Water Leakage: No water leakage through the assembly or joints, when tested in conformance with both ASTM E 331 (uniform static air pressure test) and AAMA 501 (dynamic pressure test) at 12 pounds per square foot minimum differential pressure.
11. Condensation Resistance Factor (CRF): Minimum CRF value of at least the following, when tested in conformance with NFRC 500.
- a. Combined Framing Members and Glazing: At least 56.
 - b. Framing Members Only: At least 70.
12. Sound Transmission Class (STC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested STC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
13. Outdoor-Indoor Transmission Class (OITC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested OITC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.

14. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
15. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified in Section 05 50 00.

D. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed sliding and storefronts. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, and undercuts. Use the same reference numbers for openings and details as the Drawings.
3. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing sliding storefront layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.

- b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference entrance door details to door schedule. Cross-reference storefront details to plans and elevations.
 - 4. Samples:
 - a. Submit at least 6-inch square representative samples of each sliding storefront framing color and finish.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished sliding storefronts.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 - 3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for sliding storefront maintenance, cleaning, and repair.
 - 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Entrance doors and storefronts must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Automatic and power-assisted doors must conform to the requirements of California Building Code Section 11B-404.3.

C. Quality Standard Requirements:

1. Entrance Door Product Standard: Comply with the requirements of ANSI/AAMA/WDMA publication ANSI/AAMA/WDMA 101/I.S.2/NAFS-02, "*Windows, Skylights and Glass Doors*".
2. Entrance Door Performance Standard: Comply with the requirements of AAMA/WDMA/CSA publication AAMA/WDMA/CSA 101/I.S.2/A440, "*NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights*".

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing sliding storefronts installed on at least 200 previous projects similar to this project in size, material, design, and complexity.

2. Installer: Company or individuals must have at least 5 years' experience installing sliding storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing sliding storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading entrance and storefront installers.
 4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.
- E. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate sliding storefronts into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective entrances or storefront materials with undamaged new items or materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. **Manufacturer Warranty:** Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years; and for finishes against color fading, chalking, cracking, checking, peeling, and adhesive failure for 20 years.
- B. **Installer Guarantee:** Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. **Sustainability performance requirements:** For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. **Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.**
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. **Building Product Disclosure and Optimization: Responsible Sourcing criteria.**
 - 1. **Pre-consumer and Post-consumer Recycled Content:**
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. **Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:**

1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
3. Preference is given to product inventoried to at least 0.01% (100 ppm).
4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. [Only include in sections with "C4a.A&S" under C4a in matrix] Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Panda Windows & Door.
 2. Nana Wall Systems, Inc.
 3. Fleetwood Windows and Doors.

2.3 SLIDING STOREFRONTS

- A. Description: Non-thermal multi-sliding doors.

- B. Product: "S.30 Panda Select Multi Slide Door" manufactured by Panda Windows & Doors, or equal.
- C. Requisite Properties:
 - 1. Faming Size: Indicated on the Drawings.
 - 2. Door Track: 1-1/4 inch recessed track.
 - 3. Glazing Thickness: Nominal one-inch.
 - 4. Exposed Finishes: Black.
 - 5. Concealed Steel Finishes: Prepare surfaces and apply shop primer.
 - 6. Concealed Aluminum Finishes: Prepare surfaces and coat aluminum surfaces in contact with masonry, concrete, or steel with bituminous paint specified Section 05 50 00.

2.4 MATERIALS

- A. Aluminum:
 - 1. Standard Aluminum Structural Profiles: ASTM B 308, Alloy 6061-T6.
 - 2. Extruded Aluminum Bars and Shapes: ASTM B 221, Alloy 6063-T5 or T6 for primary components; Alloy 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
 - 3. Aluminum Sheet and Plate: ASTM B 209, Alloy 5005-H32 or Alloy 3003-H14.
 - 4. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.
 - 5. Structural Aluminum Pipe and Round Tube: ASTM B 429.
- B. Glazing: Specified in Section 08 81 00.

2.5 ACCESSORIES

- A. Steel Reinforcement: When required by engineering calculations, provide steel bent plate or shapes conforming to ASTM A 36 and shop primed.
- B. Brackets: Provide high-strength aluminum or austenitic stainless steel brackets and reinforcements.
- C. Hardware: Manufacturer's standard factory-installed operating hardware, finish must match adjacent door hardware.
- D. Glazing Gaskets: Manufacturer's standard ethylene propylene diene monomer (EPDM) conforming to ASTM C 864 and having a Shore A hardness value of at least 70, unless another type of gasket is supplied, required, recommended, or accepted by the manufacturer.
- E. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce framing members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- F. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
1. Install sliding storefronts using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 4. Installed sliding storefronts must be warrantable. Do not install, correct, or replace sliding storefronts in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Use concealed fasteners and anchorages. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces and to make weathertight connections.
2. Form closely-fitted joints with exposed connections accurately located and secured.
3. Provide uniform-width perimeter reveals and opening sealants and joint fillers as indicated.
4. Install concealed gaskets, flashings, and joint fillers as the storefront installation progresses.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach sliding storefronts to supporting construction.

D. Installation Tolerances: Install storefronts within the following tolerance variations.

1. Maximum Variation from True Position: Not more than 1/8-inch in 12 feet nor more than 1/4-inch over any total length.
2. Maximum Variation from Plane: Not more than 1/8-inch in 12 feet nor more than 1/2-inch over any total length.
3. Maximum Out of Plumb: Not more than 1/8-inch in 10 feet nor more than 1/4-inch in any 40-foot run.
4. Maximum Out of Level: Not more than 1/8-inch in 20 feet nor more than 1/4-inch in any 40-foot run.
5. Maximum Misalignment of Adjacent Members: 1/16-inch.
6. Maximum Offset between Components at Joints:
 - a. In-line Surfaces: Not more than 1/16-inch, except that offset are not allowed at welded joints.
 - b. Corners: : Not more than 1/32-inch
7. Squareness: Not more than 1/8-inch difference in diagonal measurements.
8. Maximum Bow: Not more than 1/16-inch in any four foot framing length.

3.3 ADJUSTING

- A. Verify smooth and quiet sliding storefront and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:

1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
2. Required Tests:
 - a. Water Leakage Hose Tests: Perform water leakage hose tests in conformance with ASTM AAMA 501.2 (fixed glazing assemblies) and AAMA 502 (operable window units).
 - b. Air and Water Leakage Chamber Tests: Perform air and water leakage chamber tests in conformance with AAMA 502, Test method B.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 PROTECTION

- A. Protect installed sliding storefronts in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed sliding storefronts unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed sliding storefronts as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 43 36 – FOLDING STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed folding storefronts.
2. Delegated design of storefront assemblies.
3. Site tests and inspections.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 81 00 for glass glazing.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AAMA: American Architectural Manufacturers Association.
2. WDMA: Window & Door Manufacturers Association.
3. CSA: Canadian Standards Association.

B. Definitions:

1. Manufacturer: Means the folding storefront manufacturer, as the context admits, unless otherwise indicated.
2. Failure: Includes noise or vibration caused by movement, material deterioration beyond normal weathering, water leakage through fixed glazing and framing areas, and failure of operating components.
3. Water Leakage: Means no uncontrolled water penetrating assemblies or water appearing on assemblies' normally-exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to the exterior.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate building opening tolerances with folding storefront manufacturing and erection tolerances.

2. Coordinate hardware preparations, handing, and reinforcement requirements and locations with the Drawings, door schedule, and selected hardware sets.
 3. Coordinate entrance door hardware finishes with other door hardware finishes.
 4. Coordinate building opening tolerances with storefront manufacturing and erection tolerances. The manufacturer must accommodate building frame tolerances.
- B. Delegated Design Requirements:
1. Engineer, fabricate, assemble, and install folding storefronts that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and result in structurally sound, non-corroding, and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
 2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.
- C. Performance Requirements:
1. General: Entrances and storefronts must establish and maintain a continuous watertight seal without failure.
 2. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, "*Minimum Design Loads and Associated Criteria for Buildings and other Structures*".
 3. Superstructure Deflection and Story Drift: Accommodate design displacement of adjacent stories indicated on the structural drawings.
 4. Seismic Loads: Resist, distribute, or transfer seismic loads indicated on the structural drawings without incipient or catastrophic failure.
 5. Perpendicular Deflection (Convexity and Concavity):
 - a. Storefront Framing Spans up to 13 Feet 6 Inches: Framing members may not deflect more than $L/175$ or 3/4-inch, whichever is less, measured normal to the assembly plane.
 - b. Storefront Framing Spans between 13 Feet 6 Inches and 40 Feet: Framing members may not deflect more than $L/240$ plus 1/4-inch, measured normal to the assembly plane.
 - c. Deflection of the horizontal sill member due to the weight of the glass should not exceed 1/8" nor should the deflection decrease the head clearance of the panel below by more than 25%.
 - d. Storefront Spans Greater than 40 Feet: Provide structural analysis.
 - e. Cantilever Deflection: Not more than $2L/175$, where "L" is the cantilever length, measured normal to the assembly plane.
 - f. Center of Glass Deflection: Not more than $L/50$ of short side length, or one inch, whichever is less, measured normal to the assembly plane.
 6. Parallel Deflection (Sagging): Limit deflection under maximum design load to either 1/8-inch or not more than 25-percent reduction in glass bite, whichever is smaller measured in line with the assembly plane.

- a. Minimum Clearance Between Framing Members and Top of Glazing or other Fixed Component Immediately Below: 1/8-inch.
 - b. Minimum Clearance Between Framing Members and Operable Components, Including Doors and Entrances: 1/16-inch.
 - c. Maximum Twisting of Doors and Entrances: Twisting (rotation) of horizontal framing members caused by glass weight may not exceed one degree, measured between the ends and the center of each span.
7. Permanent Deformation: No permanent deformation at design pressure. Limit permanent deformation to 0.2 percent of the clear span of any framing member, when tested in conformance with ASTM E 330 (uniform static pressure test).
 - a. Maximum Positive and Negative Test Loads: Equal to at least the specified design pressure.
 - b. Maximum Positive and Negative Proof Loads for Vertical Glazing: At least equal to 1.5 times the design pressure.
 - c. Maximum Positive and Negative Proof Loads for Sloped Glazed Assemblies: At least equal to 2.0 times the design pressure.
 - d. Duration of Maximum Test and Proof Loads: 10 seconds.
 - e. Measurement: The number and location of deflection measurements must be shown on the mockup shop drawings prior to testing. At a minimum, indicate measurement of deflection at maximum deflection and end deflection locations
8. Thermal Transmittance (U-Factor): Maximum assembly thermal transmittance value may not exceed the following.
 - a. Maximum Winter Nighttime Transmittance (U-value): Not more than 0.36 for fixed assemblies; and 0.46 BTU per hour per square foot per deg. F. for operable assemblies.
 - b. Maximum Summer Daytime Transmittance (U-value): Not more than 0.42 BTU per hour per square foot per deg. F.
9. Air Leakage (AL): Maximum permanent AL rating of not more than 0.06 cubic feet per minute per square foot, when tested in conformance with ASTM E 283 at 6.24 pounds per square foot minimum differential static air pressure.
10. Water Leakage: No water leakage through the assembly or joints, when tested in conformance with both ASTM E 331 (uniform static air pressure test) and AAMA 501 (dynamic pressure test) at 12 pounds per square foot minimum differential pressure.
11. Condensation Resistance Factor (CRF): Minimum CRF value of at least the following, when tested in conformance with NFRC 500.
 - a. Combined Framing Members and Glazing: At least 56.
 - b. Framing Members Only: At least 70.
12. Sound Transmission Class (STC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested STC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
13. Outdoor-Indoor Transmission Class (OITC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested OITC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.

14. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
15. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified in Section 05 50 00.

D. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed folding and storefronts. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
2. Door Schedule: Submit schedule showing opening identification symbols and door and frame types and sizes, including thickness, swing, fire-resistance rating label requirements, and undercuts. Use the same reference numbers for openings and details as the Drawings.
3. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing folding storefront layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.

- b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference entrance door details to door schedule. Cross-reference storefront details to plans and elevations.
 - 4. Samples:
 - a. Submit at least 6-inch square representative samples of each folding storefront framing color and finish.
- B. Informational Submittals: Submit the following for information (informal review; responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished folding storefronts.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 - 3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for folding storefront maintenance, cleaning, and repair.
 - 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Entrance doors and storefronts must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Automatic and power-assisted doors must conform to the requirements of California Building Code Section 11B-404.3.

C. Quality Standard Requirements:

1. Entrance Door Product Standard: Comply with the requirements of ANSI/AAMA/WDMA publication ANSI/AAMA/WDMA 101/I.S.2/NAFS-02, "*Windows, Skylights and Glass Doors*".
2. Entrance Door Performance Standard: Comply with the requirements of AAMA/WDMA/CSA publication AAMA/WDMA/CSA 101/I.S.2/A440, "*NAFS - North American Fenestration Standard/Specification for Windows, Doors, and Skylights*".

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing folding storefronts installed on at least 200 previous projects similar to this project in size, material, design, and complexity.

2. Installer: Company or individuals must have at least 5 years' experience installing folding storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing folding storefronts for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading entrance and storefront installers.
 4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.
- E. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate folding storefronts into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective entrances or storefront materials with undamaged new items or materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. **Manufacturer Warranty:** Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years; and for finishes against color fading, chalking, cracking, checking, peeling, and adhesive failure for 20 years.
- B. **Installer Guarantee:** Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. **Sustainability performance requirements:** For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. **Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.**
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. **Building Product Disclosure and Optimization: Responsible Sourcing criteria.**
 - 1. **Pre-consumer and Post-consumer Recycled Content:**
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. **Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:**

1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
3. Preference is given to product inventoried to at least 0.01% (100 ppm).
4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Panda Windows & Door.
 2. Nana Wall Systems, Inc.
 3. Fleetwood Windows and Doors.

2.3 FOLDING STOREFRONTS

- A. Description: Thermally broken multi-folding doors.

- B. Product: "TS.60 Panda Folding Door" manufactured by Panda Windows & Doors, or equal.
- C. Requisite Properties:
 - 1. Faming Size: Indicated on the Drawings.
 - 2. Door Track: 1-1/2 inch ADA recessed track.
 - 3. Glazing Thickness: Nominal one-inch.
 - 4. Exposed Finishes: Black.
 - 5. Concealed Steel Finishes: Prepare surfaces and apply shop primer.
 - 6. Concealed Aluminum Finishes: Prepare surfaces and coat aluminum surfaces in contact with masonry, concrete, or steel with bituminous paint specified Section 05 50 00.

2.4 MATERIALS

- A. Aluminum:
 - 1. Standard Aluminum Structural Profiles: ASTM B 308, Alloy 6061-T6.
 - 2. Extruded Aluminum Bars and Shapes: ASTM B 221, Alloy 6063-T5 or T6 for primary components; Alloy 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
 - 3. Aluminum Sheet and Plate: ASTM B 209, Alloy 5005-H32 or Alloy 3003-H14.
 - 4. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.
 - 5. Structural Aluminum Pipe and Round Tube: ASTM B 429.
- B. Glazing: Specified in Section 08 81 00.

2.5 ACCESSORIES

- A. Steel Reinforcement: When required by engineering calculations, provide steel bent plate or shapes conforming to ASTM A 36 and shop primed.
- B. Brackets: Provide high-strength aluminum or austenitic stainless steel brackets and reinforcements.
- C. Hardware: Manufacturer's standard factory-installed operating hardware, finish must match adjacent door hardware.
- D. Glazing Gaskets: Manufacturer's standard ethylene propylene diene monomer (EPDM) conforming to ASTM C 864 and having a Shore A hardness value of at least 70, unless another type of gasket is supplied, required, recommended, or accepted by the manufacturer.
- E. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce framing members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- F. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
1. Install folding storefronts using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 4. Installed folding storefronts must be warrantable. Do not install, correct, or replace folding storefronts in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Use concealed fasteners and anchorages. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces and to make weathertight connections.
2. Form closely-fitted joints with exposed connections accurately located and secured.
3. Provide uniform-width perimeter reveals and opening sealants and joint fillers as indicated.
4. Install concealed gaskets, flashings, and joint fillers as the storefront installation progresses.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach folding storefronts to supporting construction.

D. Installation Tolerances: Install storefronts within the following tolerance variations.

1. Maximum Variation from True Position: Not more than 1/8-inch in 12 feet nor more than 1/4-inch over any total length.
2. Maximum Variation from Plane: Not more than 1/8-inch in 12 feet nor more than 1/2-inch over any total length.
3. Maximum Out of Plumb: Not more than 1/8-inch in 10 feet nor more than 1/4-inch in any 40-foot run.
4. Maximum Out of Level: Not more than 1/8-inch in 20 feet nor more than 1/4-inch in any 40-foot run.
5. Maximum Misalignment of Adjacent Members: 1/16-inch.
6. Maximum Offset between Components at Joints:
 - a. In-line Surfaces: Not more than 1/16-inch, except that offset are not allowed at welded joints.
 - b. Corners: Not more than 1/32-inch
7. Squareness: Not more than 1/8-inch difference in diagonal measurements.
8. Maximum Bow: Not more than 1/16-inch in any four foot framing length.

3.3 ADJUSTING

- A. Verify smooth and quiet folding storefront and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:

1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
2. Required Tests:
 - a. Water Leakage Hose Tests: Perform water leakage hose tests in conformance with ASTM AAMA 501.2 (fixed glazing assemblies) and AAMA 502 (operable window units).
 - b. Air and Water Leakage Chamber Tests: Perform air and water leakage chamber tests in conformance with AAMA 502, Test method B.

3.5 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.6 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.7 PROTECTION

- A. Protect installed folding storefronts in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed folding storefronts unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed folding storefronts as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 44 13 – STANDARD ALUMINUM-FRAMED CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard glazed aluminum curtain walls.
2. Delegated design of curtain wall assemblies.
3. Site tests and inspections.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 08 41 13 for entrance doors.
3. Section 08 81 00 for glass glazing.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AAMA: American Architectural Manufacturers Association.

B. Definitions:

1. Manufacturer: Means the curtain wall manufacturer, unless otherwise indicated.
2. Failure: Includes noise or vibration caused by movement, material deterioration beyond normal weathering, water leakage through fixed glazing and framing areas, and failure of operating components.
3. Water Leakage: Means no uncontrolled water penetrating assemblies or water appearing on assemblies' normally-exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to the exterior.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate building superstructure and design movement tolerances with curtain wall manufacturing and erection tolerances. The manufacturer must accommodate building frame tolerances.

B. Delegated Design Requirements:

1. Engineer, fabricate, assemble, and install curtain walls that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and result in structurally sound, non-corroding, and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
 2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.
- C. Performance Requirements:
1. General: Curtain walls must establish and maintain a continuous watertight seal without failure.
 2. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, "*Minimum Design Loads and Associated Criteria for Buildings and other Structures*".
 3. Superstructure Deflection and Story Drift: Accommodate design displacement of adjacent stories indicated on the structural drawings.
 4. Seismic Loads: Resist, distribute, or transfer seismic loads indicated on the structural drawings without incipient or catastrophic failure.
 5. Perpendicular Deflection (Convexity and Concavity):
 - a. Curtain wall Framing Spans up to 13 Feet 6 Inches: Framing members may not deflect more than $L/175$ or 3/4-inch, whichever is less, measured normal to the assembly plane.
 - b. Curtain wall Framing Spans between 13 Feet 6 Inches and 40 Feet: Framing members may not deflect more than $L/240$ plus 1/4-inch, measured normal to the assembly plane.
 - c. Curtain wall Spans Greater than 40 Feet: Provide structural analysis.
 - d. Cantilever Deflection: Not more than $2L/175$, where "L" is the cantilever length, measured normal to the assembly plane.
 - e. Center of Glass Deflection: Not more than $L/50$ of short side length, or one inch, whichever is less, measured normal to the assembly plane.
 6. Parallel Deflection (Sagging): Limit deflection under maximum design load to either 1/8-inch or not more than 25-percent reduction in glass bite, whichever is smaller measured in line with the assembly plane.
 - a. Minimum Clearance Between Framing Members and Top of Glazing or Other Fixed Component Immediately Below: At least 1/8-inch.
 - b. Minimum Clearance Between Framing Members and Operable Components, Including Doors and Entrances: At least 1/16-inch.
 - c. Maximum Twisting of Doors and Entrances: Twisting (rotation) of horizontal framing members caused by glass weight may not exceed one degree, measured between the ends and the center of each span.
 7. Permanent Deformation: No permanent deformation at design pressure. Limit permanent deformation to 0.2 percent of the clear span of any framing member, when tested in conformance with ASTM E 330 (uniform static pressure test).

- a. Maximum Positive and Negative Test Loads: Equal to at least the specified design pressure.
 - b. Maximum Positive and Negative Proof Loads for Vertical Glazing: At least equal to 1.5 times the design pressure.
 - c. Maximum Positive and Negative Proof Loads for Sloped Glazed Assemblies: At least equal to 2.0 times the design pressure.
 - d. Duration of Maximum Test and Proof Loads: 10 seconds.
 - e. Measurement: The number and location of deflection measurements must be shown on the mockup shop drawings prior to testing. At a minimum, indicate measurement of deflection at maximum deflection and end deflection locations
8. Thermal Transmittance (U-Factor): Maximum assembly thermal transmittance value may not exceed the following.
- a. Maximum Winter Nighttime Transmittance (U-value): Not more than 0.36 for fixed assemblies; and 0.46 BTU per hour per square foot per deg. F. for operable assemblies.
 - b. Maximum Summer Daytime Transmittance (U-value): Not more than 0.42 BTU per hour per square foot per deg. F.
9. Air Leakage (AL): Maximum permanent AL rating of not more than 0.06 cubic feet per minute per square foot, when tested in conformance with ASTM E 283 at 6.24 pounds per square foot minimum differential static air pressure.
10. Water Leakage: No water leakage through the assembly or joints, when tested in conformance with both ASTM E 331 (uniform static air pressure test) and AAMA 501 (dynamic pressure test) at 12 pounds per square foot minimum differential pressure.
11. Condensation Resistance Factor (CRF): Minimum CRF value of at least the following, when tested in conformance with NFRC 500.
- a. Combined Framing Members and Glazing: At least 56.
 - b. Framing Members Only: At least 70.
12. Sound Transmission Class (STC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested STC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
13. Outdoor-Indoor Transmission Class (OITC): Provide complete assemblies (both frame and glazing) having a minimum laboratory-tested OITC value of at least that indicated on the Drawings for glass and frame together, as determined in conformance with ASTM E 413, based on testing in conformance with ASTM E 90.
14. Thermal Expansion and Contraction: Accommodate movement resulting from at least 120 deg. F ambient and 180 deg. F material surface temperature differentials (changes).
15. Dissimilar Metal Corrosion Protection: Permanently isolate metal surfaces from direct contact with incompatible materials and other potentially corrosive substrates as specified in Section 05 50 00.

D. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.

2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed curtain walls. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing curtain wall layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
 3. Samples:
 - a. Submit at least 6-inch square representative samples of each curtain wall framing color and finish.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished curtain walls.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.

- b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 - 3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

- 1. Curtain walls must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).

- a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Qualifications:
1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing curtain walls installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
 2. Installer: Company or individuals must have at least 5 years' experience installing curtain walls for at least 30 previous projects similar to this project in size, material, design, and complexity.
 3. Supervisors: Individuals must have at least 7 years' experience installing curtain walls for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading curtain wall installers.
 4. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.
- C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate curtain walls into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.

4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective curtain wall materials with undamaged new curtain wall materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years; and for finishes against color fading, chalking, cracking, checking, peeling, and adhesive failure for 20 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.

- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
 - 1. Arcadia.
 - 2. EFCO Corp.
 - 3. Kawneer Co., Inc.
 - 4. Wausau Window and Wall Systems.
 - 5. YKK AP America, Inc.

2.3 GLAZED ALUMINUM CURTAIN WALLS

- A. Products: "T500 (OPG3000) Series" thermal framing manufactured by Arcadia, or equal.
- B. Requisite Properties:
 - 1. Framing Size: 2-1/4 inches by 10 inches.
 - 2. Glazing Thickness: One-inch.
 - 3. Glazing Installation: Outside glazed.
 - 4. Exposed Finishes: Match storefront framing.
 - 5. Concealed Steel Finishes: Prepare surfaces and apply shop primer specified in Section 05 05 13.
 - 6. Concealed Aluminum Finishes: Prepare surfaces and coat aluminum surfaces in contact with masonry, concrete, or steel with bituminous paint specified Section 05 50 00.

2.4 MATERIALS

- A. Steel:
 - 1. Hot-Rolled Steel Rods, Bars, Shapes, and Plate: ASTM A 36 (mild steel), merchant quality.
- B. Stainless Steel:
 - 1. Stainless Steel Coil, Sheet, Strip, Plate, and Flat Bar: Exposed Locations: ASTM A 666 (annealed and tempered), Type 304L (for welded applications) or Type 304 (for all other applications), annealed, and at least 1/4H temper (hardness between Rockwell B-60 and 75; can be bent 180 degrees across the direction of rolling over one thickness of the strip and 90 degrees in the direction of rolling around a radius equal to its thickness).
 - a. Items Indicated to have an Uncoated (Bare) or Natural Finish: Furnish materials having a No. 2B (bright) finish.
 - b. Items Indicated to have a Painted Finish: Furnish materials having a No. 2D (matte) finish.
- C. Aluminum:
 - 1. Standard Aluminum Structural Profiles: ASTM B 308, Alloy 6061-T6.

2. Extruded Aluminum Bars and Shapes: ASTM B 221, Alloy 6063-T5 or T6 for primary components; Alloy 6063-T5 or T6, 6005-T5, 6105-T5 or 6061-T6 for structural components.
3. Aluminum Sheet and Plate: ASTM B 209, Alloy 5005-H32 or Alloy 3003-H14.
4. Extruded Aluminum Tubes: ASTM B 221 or ASTM B 483.
5. Structural Aluminum Pipe and Round Tube: ASTM B 429.

D. Glazing: Specified in Section 08 81 00.

2.5 ACCESSORIES

- A. Steel Reinforcement: When required by engineering calculations, provide steel bent plate or shapes conforming to ASTM A 36 and shop primed in conformance with Section 05 05 13.
- B. Brackets: Provide high-strength aluminum or austenitic stainless steel brackets and reinforcements.
- C. Sill Flashing: Fabricate from at least 0.060-inch thick aluminum sheet, with welded end dams and finished to match frames.
- D. Concealed Flashing: Stainless steel sheet conforming to ASTM A 240 (annealed) Type 04 (for all other applications), No. 2D (matte) finish, annealed, No. 4 (soft) temper (hardness not more than Rockwell B-65; can be bent flat upon itself in any direction).
- E. Movement Joints: Slip-joint linings, slip pads, spacers, and sleeves of material and type supplied, required, recommended, approved, or accepted by the manufacturer.
- F. Glazing Gaskets: Manufacturer's standard ethylene propylene diene monomer (EPDM) conforming to ASTM C 864 and having a Shore A hardness value of at least 70, unless another type of gasket is supplied, required, recommended, or accepted by the manufacturer.
- G. Silicone Gutter Gaskets: Custom extrusions installed with low modulus single-component sealant specified in Section 07 92 00.
- H. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
 1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 2. Reinforce framing members as required to receive fastener threads.
 3. Exposed fasteners are prohibited on faces exposed to view. Provide concealed fasteners and expansion provisions.
- I. Anchors:

1. Anchor Bolts (Anchor Rods): Cast-in-place anchors specified in Section 05 05 23 having minimum 60 ksi tensile strength.
2. Other Anchors:
 - a. Three-way adjustable anchors that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by the manufacturer.
 - b. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.
- J. Cleaning Agent and Cloth: Supplied, required, recommended, or accepted by the structural sealant manufacturer.
- K. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 1. Install curtain walls using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction

3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 4. Installed curtain walls must be warrantable. Do not install, correct, or replace curtain walls in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Use concealed fasteners and anchorages. Provide washer head fasteners with bonded sealing washers where required to protect metal surfaces and to make weathertight connections.
 2. Form closely-fitted joints with exposed connections accurately located and secured.
 3. Provide uniform-width perimeter reveals and opening sealants and joint fillers as indicated.
 4. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so that no evidence remains of corrective work. Return to the factory those items that either cannot be refinished in the field, or that contain components that cannot be refinished in the field; make required alterations; and either refinish the entire item or provide a new item.
 5. Install concealed gaskets, flashings, and joint fillers as the curtain wall installation progresses.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach curtain walls to supporting construction.
- D. Installation Tolerances: Install curtain walls within the following tolerance variations.
1. Maximum Variation from True Position: Not more than 1/8-inch in 12 feet nor more than 1/4-inch over any total length.
 2. Maximum Variation from Plane: Not more than 1/8-inch in 12 feet nor more than 1/2-inch over any total length.
 3. Maximum Out of Plumb: Not more than 1/8-inch in 10 feet nor more than 1/4-inch in any 40-foot run.
 4. Maximum Out of Level: Not more than 1/8-inch in 20 feet nor more than 1/4-inch in any 40-foot run.
 5. Maximum Out of Alignment:
 - a. Up to 1/2-inch Reveals or Protruding Elements: Not more than 1/16-inch
 - b. 1/2- to One-inch Reveals or Protruding Elements: Not more than 1/8-inch
 - c. Greater than One-inch Reveals or Protruding Elements: Not more than 1/4-inch
 6. Maximum Misalignment of Adjacent Members: 1/16-inch.
 7. Maximum Offset between Components at Joints:
 - a. In-line Surfaces: Not more than 1/16-inch, except that offset are not allowed at welded joints.
 - b. Corners: : Not more than 1/32-inch
 8. Squareness: Not more than 1/8-inch difference in diagonal measurements.
 9. Maximum Bow: Not more than 1/16-inch in any four foot framing length.

3.3 FIELD QUALITY CONTROL

A. Site Tests and Inspections:

1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.
 - c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
2. Required Tests:
 - a. Water Leakage Hose Tests: Perform water leakage hose tests in conformance with ASTM AAMA 501.2 (fixed glazing assemblies) and AAMA 502 (operable window units).
 - b. Air and Water Leakage Chamber Tests: Perform air and water leakage chamber tests in conformance with AAMA 502, Test method B.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed curtain walls in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed curtain walls unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed curtain walls as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Storefront and entrance door hardware.
3. Gate Hardware.
4. Third-party inspection report for fire-rated door assemblies.
5. Battery-powered electronic credential access control locks and panic hardware lever trim.
6. Power supplies for electric hardware.
7. Door position switches.
8. Cylinders for doors fabricated with locking hardware.
9. Key management software.

B. Related Divisions:

1. Division 06 – door hardware installation
2. Division 07 – sealant at exterior thresholds
3. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, specialty doors, storefront and glazed curtainwall systems.
4. Division 10 – operable partitions
5. Division 21 – fire and life safety systems
6. Division 28 – security access systems

D. 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. Sliding aluminum doors, except cylinders where detailed.
10. Access doors and panels, except cylinders where detailed.
11. Corner Guards.
12. Welded steel gates and supports.

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 2019 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 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

- A. SUBMITTALS: Submit six copies of schedule per D. Only submittals printed one sided will be accepted and reviewed. 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. Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.
- B. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- C. 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.
- D. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.

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: low-voltage power supply locations.
 - 7. Coordinate: back-up power for doors with automatic operators.
 - 8. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
 - 9. 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 to validate warranty information, required for Owner in making future warranty claims:
- 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 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.

1.9 REGULATORY REQUIREMENTS:

A. Locate latching hardware between 34 inches to 44 inches above the finished floor, per-2022 California Building Code, Section 11B-404.2.7.

1. Panic hardware: locate between 36 inches to 44 inches above the finished floor.

B. Handles, pull, latches, locks, other operable parts:

1. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate. 2022 California Building Code Section 11B-309.4.
2. Force required to activate the operable parts: 5.0 pounds maximum, per 2022 California Building Code Section 11B-309.4.

C. 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.

1. 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.

D. Low-energy powered doors: comply with ANSI/BHMA A156.19. Reference: 2022 California Building Code Section 11B-404.2.9.

1. Where powered door serves an occupancy of 100 or more, provide back-up battery power or stand-by generator power, capable of supporting a minimum of 100 cycles.

2. Actuators, vertical bar type: minimum 2-inches wide, 30-inches high, bottom located minimum 5-inches above floor or ground, top located minimum 35-inches above floor or ground. Displays International Symbol of Accessibility, per 2022 California Building Code Section 11B-703.7.
 3. Actuators, plate type: use two at each side of the opening. Minimum 4-inches diameter or 4-inches square. Displays International Symbol of Accessibility, per 2022 California Building Code Section 11B-703.7. Locate centerline of lower plate between 7- and 8-inches above floor or ground, and upper plate between 30- and 44-inches above floor or ground.
 4. Actuator location: conspicuously located, clear and level floor/ground space for forward or parallel approach.
- E. Adjust door closer sweep periods so that from an open position of 90 degrees, the door will take at least 5 seconds to move to a point 12 degrees from the latch, measured to the landing side of the door, per 2022 California Building Code Section 11B-404.2.8.
1. Spring hinges: adjust for 1.5 seconds minimum for 70 degrees to fully-closed.
- F. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per 2022 California Building Code Section 11B-404.2.10.
1. Applied kickplates and armor plates: bevel the left and right edges; free of sharp or abrasive edges.
 2. Tempered glass doors without stiles: bottom rail may be less than 10 inches if top leading edge is tapered 60 degrees minimum.
- G. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and below 80 inches, and the hardware projects no more than 4 inches. 2022 California Building Code Section 11B-404.2.3.
1. Exception: doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
 2. Door closers and overhead stops: not less than 78 inches above the finished floor or ground, per 2022 California Building Code 11B-307.4.
- H. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway, per 2022 California Building Code Section 11B-404.2.5. Vertical rise no more than 0.25 inches, change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). 2022 California Building Code Section 11B-303.2 & ~.3.
- I. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- J. Pairs of doors with independently-activated hardware both leaves: limit swing of right-hand or right-hand-reverse leaf to 90 degrees to protect persons reading wall-mounted tactile signage, per 2022 California Building Code Section 11B-703.4.2.

- K. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door may not encroach/project more than 7 inches into the required exit width, with the exception of door release hardware such as lockset levers or panic hardware. These hardware items must be located no less than 34-inches and no more than 48-inches above the floor/ground. 2022 California Building Code, Section 1005.7.1.
- 2. In I-2 occupancies, surface mounted latch release hardware, mounted to the side of the door facing away from the adjacent wall where the door is in the open position, is not exempt from the inclusion in the 7-inch maximum encroachment, regardless of its mounting height, per 2022 California Building Code, Section 1005.7.1 at Exception 1.

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
Continuous Hinges	(IVE) Ives	Select
Pivots	(IVE) Ives	Rixson
Floor Closers	(RIX) Rixson	Dorma
Key System	(SCH) Schlage	Owner standard
Mechanical Locks	(SCH) Schlage	Owner standard
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
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Overhead Stops	(GLY) Glynn-Johnson	ABH
Thresholds	(ZER) Zero	NGP, Pemko
Seals & Bottoms	(ZER) Zero	NGP, Pemko
Key Cabinets	(LUN) Lund	TelKee
Aluminum Door Locks	(ADA) Adams Rite	None

2.2 HINGING METHODS:

- A. 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.
- B. 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.
- C. 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: non-ferrous with non-removable (NRP) pins and security studs.
 - 2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
- D. Continuous Hinges:
 - 1. Geared-type aluminum.
 - a) Use wide-throw units where needed for maximum degree of swing, advise architect if commonly available hinges are insufficient.
 - b) If units are used at storefront openings, color-coordinate hinge finish with storefront color. Custom anodizing and custom powdercoat finishes subject to Architect approval.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

- A. Mortise Locksets and Latchsets: as scheduled.
 - 1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
 - 2. Universal lock case – 10 functions in one case.
 - 3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
 - 4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
 - 5. 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.
 - d) Vandalgard locks: locked lever freely rotates down while remaining securely locked. This feature prevents damage to internal lock components when subjected to excessive force.
 - 6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.

7. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
8. Deadbolts: stainless steel 1-inch throw.
9. Electric operation: Manufacturer-installed continuous duty solenoid.
10. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
11. Scheduled Lock Series and Design: Schlage L series, 17A design.
12. Certifications:
 - a) ANSI A156.13, Grade 1 Operational, Grade 1 Security.
 - b) ANSI/ASTM F476-84 Grade 31 UL Listed.
13. 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. Exterior doors scheduled with XP-series devices: Static load force resistance of at least 2000 pounds.
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: Von Duprin "AX-" feature, where touchpad directly retracts the latchbolt with 5 lb or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb requirement.
 - b) Electrical method: Von Duprin's "RX-QEL-", where lightly pressing the touchpad with 5 lb or less of force closes an electric switch, activating quiet electric latch retraction.

B. Specific features:

1. Non-Fire Rated Devices: cylinder dogging.
2. Lever Trim: breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Rod and latch guards with sloped full-width kickplates for doors fitted with surface vertical rod devices with bottom latches.

4. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
5. Impact 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.
6. Delayed Egress Devices: Function achieved within single exit device component, including latch, delayed locking device, request-to-exit switch, nuisance alarm, remote alarm, key switch, indicator lamp, relay, internal horn, door position input, external inhibit input plus fire alarm input. NFPA 101 "Special Locking Arrangement" compliant.
7. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
8. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key. Furnish storage brackets for securely stowing the mullion away from the door when removed.
9. Accepted substitutions: None

2.6 CLOSERS

C. Surface Closers:

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.

13. Accepted substitutions: None

2.7 OTHER HARDWARE

- A. Automatic Flush Bolts: Low operating force design.
- B. Overhead Stops: Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.
- C. 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.
- D. 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.
- E. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
 - 1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.
- F. 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. Fire-rated openings, 90-minutes or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, include a 0.25in high 5in wide saddle in the bid, and request direction from Architect.
 - 5. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
 - 6. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
 - 7. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

- 8. 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.
 - G. 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.
 - H. 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.
 - I. Key Control Software: Same manufacturer as key cylinders, supply to Owner.
- 2.8 FINISH:
- A. Generally: BHMA 622 Matte Black.
 - B. Door closers: factory powder coated to match other hardware, unless otherwise noted.
- 2.9 KEYING REQUIREMENTS:
- A. Key System: (Verify with owner) Schlage Everest [D] utility-patented keyway, interchangeable core. Utility patent protection to extend at least until 2029. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with Owner and Allegion representatives to determine system keyway(s), keybow styles, structure and degree of geographic exclusivity. Furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the Owner. Owner will install permanent cylinders/cores.
 - B. Keys
 - 1. New factory registered master key system.
 - 2. Construction keying: furnish temporary keyed-alike cores. Remove at substantial completion and install permanent cylinders/cores in Owner's presence. Demonstrate that construction key no longer operates.
 - 3. Furnish 10 construction keys.
 - 4. Furnish 2 construction control keys.
 - C. Key Cylinders: furnish utility patented, 6-pin solid brass construction.
 - D. Cylinder cores: furnish keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer.
 - E. Permanent keys: use secured shipment direct from point of origination to Owner.

1. For estimate: 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
2. For estimate: VKC stamping plus "DO NOT DUPLICATE".
3. Bitting List: use 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.
 1. 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.
 2. Locate panic hardware between 36 inches to 44 inches above the finished floor.
 3. 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 than 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. Inspection of fire door assemblies and means-of-egress panic-hardware doors: Per 2019 NFPA-80 5.2.1: hire an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware.
1. Per 2019 NFPA-80 5.2.1: Use a third party inspector not associated with the construction, supply or installation of this project to develop a field survey of the doors and hardware. Survey is to be done by a member certified as a FDAI (Fire Door Assembly Inspector), Certified AHC (Architectural Hardware Consultant) or a certified testing laboratory: UL or Intertek. Certified Inspectors may be found at DHI.org, Intertek, or CAFDI.org.
- C. 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.
- D. 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.
 2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
 3. Has identified items that have deteriorated or failed.
 4. Has submitted written report identifying problems.

3.5 DEMONSTRATION:

- A. 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.
- B. Do not order material until submittal has been reviewed, stamped, and signed by Architect's door hardware consultant.
- C. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

OVERTUR 104771 V1 /OPT0355091

HARDWARE GROUP NO. 01

For use on Door #(s):

101 106B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	315AN	IVE
1	EA	ELEC PANIC HARDWARE	L/SW-PA-AX-98-EO-ALK 9-VOLT BATTERY WITH HARDWIRED OPTION	✓ 315	VON
1	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11- 948 36-083 36-082-037	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	MOUNTING PLATE	4040XP-18 SRT	693	LCN
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	8198BK	BK	ZER
1	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE

DOOR CONTACT TO BE PROVIDED BY DIVISION 28
PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 02

For use on Door #(s):

102A 102B 103A 103B 104A 104B
105A 105B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 03

For use on Door #(s):

106A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	315AN	IVE
1	EA	PANIC HARDWARE	CD-PA-AX-9849-EO-LBL	315	VON
1	EA	PANIC HARDWARE	CD-PA-AX-9849-NL-OP-110MD-LBL	315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
2	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11-948 36-083 36-082-037	622	SCH
3	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
2	EA	SURFACE CLOSER	4040XP HEDA	693	LCN
1	EA	MOUNTING PLATE	4040XP-18 SRT	693	LCN

PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 04

For use on Door #(s):

107

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	PASSAGE SET	L9010 17A	622	SCH
1	EA	SURFACE CLOSER	4040XP H TBSRT	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	BLK	IVE
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 05

For use on Door #(s):

108

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 5 X 4.5 NRP	BBLK/ 622	IVE
1	EA	PANIC HARDWARE	LD-PA-AX-98-L-NL-17	315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	8198BK	BK	ZER
3	EA	SILENCER	SR64	GRY	IVE
1	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE

****DOOR CONTACT TO BE PROVIDED BY DIVISION 28****

HARDWARE GROUP NO. 06

For use on Door #(s):

109A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	PANIC HARDWARE	CD-PA-AX-98-L-17	315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
1	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11- 948 36-083 36-082-037	622	SCH
2	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP HEDA TBSRT	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 07

For use on Door #(s):

109B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	BBLK/ 622	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW12	✓ BBLK/ 622	IVE
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-98-L-NL-17	✓ 315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	BLK	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	SET	GASKETING	328BK-S (AT JAMB LEGS)	BK	ZER
1	SET	GASKETING	429BK-S (AT HEAD)	BK	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	8198BK	BK	ZER
1	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS 900-BBK 120/240 VAC	✓	VON
1		CARD READER	CARD READER - WORK OF DIVISION 28		

** CARD READER AND POWER SUPPLY BY DIVISION 28**

HARDWARE GROUP NO. 08

For use on Door #(s):

110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A 09-544	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 09

For use on Door #(s):

111 117B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE
PERIMETER SEAL BY FRAME MANUFACURER					

HARDWARE GROUP NO. 10

For use on Door #(s):

112

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW4	✎ BBLK/ 622	IVE
1	EA	EU MORTISE LOCK	L9092TEU 17A CON 12/24 VDC	✎ 622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE
1	EA	GASKETING	488FSBK PSA	BK	ZER
1		CARD READER	CARD READER - WORK OF DIVISION 28		
1	EA	POWER SUPPLY	POWER SUPPLY - WORK OF DIVISION 28		BYO

HARDWARE GROUP NO. 11

For use on Door #(s):

113 130

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	BBLK/ 622	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT	693	LCN

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 12

For use on Door #(s):

114 141 142

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 17A 09-544 OS-OCC	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	BLK	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	BLK	IVE
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR BOTTOM	320AA	AA	ZER
1	EA	COAT AND HAT HOOK	571	ABLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 13

For use on Door #(s):

115

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	BBLK/ 622	IVE
1	EA	STOREROOM LOCK	L9080T 17A	622	SCH
1	EA	LOCK GUARD	LG10	600	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	8198BK	BK	ZER
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 14

For use on Door #(s):

116

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	315AN	IVE
1	EA	PANIC HARDWARE	CD-PA-AX-9849-EO-LBL	315	VON
1	EA	PANIC HARDWARE	CD-PA-AX-9849-NL-OP-110MD-LBL	315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
2	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11-948 36-083 36-082-037	622	SCH
3	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
2	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	MOUNTING PLATE	4040XP-18 SRT	693	LCN
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
2	EA	DOOR SWEEP	8198BK	BK	ZER
2	EA	DOOR CONTACT	679-05HM	BLK	SCE

****DOOR CONTACT TO BE PROVIDED BY DIVISION 28****

PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 14A

For use on Door #(s):

140

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	315AN	IVE
1	EA	PANIC HARDWARE	CD-PA-AX-98-NL-OP-110MD	315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
2	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11-948 36-083 36-082-037	622	SCH
3	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	MOUNTING PLATE	4040XP-18 SRT	693	LCN
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	8198BK	BK	ZER
1	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE
1	EA	SURFACE MOUNT ALARM	PG21	✓ BLK	ALA

DOOR CONTACT TO BE PROVIDED BY DIVISION 28

PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 15

For use on Door #(s):

117A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	BBLK/ 622	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	OH STOP	100S ADJ	BLK	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 16

For use on Door #(s):

118

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	FSIC CORE	23-030 EV29 T	622	SCH

ALL OTHER HARDWARE BY DOOR MANUFACTURER

HARDWARE GROUP NO. 17

For use on Door #(s):

119

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY EPT	315AN	IVE
2	EA	POWER TRANSFER	EPT10	✓ 695	VON
1	EA	ELEC PANIC HARDWARE	QELX-PA-AX-9849-EO-LBL	✓ 315	VON
1	EA	ELEC PANIC HARDWARE	QELX-PA-AX-9849-NL-OP-110MD-LBL	✓ 315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	AUTO OPERATOR	M-FORCE	✓ BLK	STA
2	EA	ACTUATOR KIT	8310-3836T	✓ 630	LCN
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
2	EA	DOOR SWEEP	8198BK	BK	ZER
2	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-4RL 900-BBK	✓	VON
			120/240 VAC		
1		CARD READER	CARD READER - WORK OF DIVISION 28		

****DOOR CONTACT TO BE PROVIDED BY DIVISION 28****

****CARD READER AND POWER SUPPLY BY DIVISION 28****

PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 17A

For use on Door #(s):

137

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY EPT	315AN	IVE
2	EA	POWER TRANSFER	EPT10	✓ 695	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-9849-EO-LBL	✓ 315	VON
1	EA	ELEC PANIC HARDWARE	RX-QELX-PA-AX-9849-NL-OP-110MD-LBL	✓ 315	VON
1	EA	RIM CYLINDER	20-057 ICX	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	90 DEG OFFSET PULL	8190EZHD 10" STD	BLK	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	693	LCN
1	EA	AUTO OPERATOR	M-FORCE	✓ BLK	STA
2	EA	ACTUATOR KIT	8310-3836T	✓ 630	LCN
2	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
2	EA	DOOR SWEEP	8198BK	BK	ZER
2	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE
1	EA	POWER SUPPLY	PS902 900-4RL 900-BBK 120/240 VAC	✓	VON
1		CARD READER	CARD READER - WORK OF DIVISION 28		

DOOR CONTACT TO BE PROVIDED BY DIVISION 28

CARD READER AND POWER SUPPLY BY DIVISION 28

PERIMETER SEAL BY DOOR/FRAME MANUFACTURER

HARDWARE GROUP NO. 18

For use on Door #(s):

120

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
ALL HARDWARE BY DOOR MANUFACTURER					

HARDWARE GROUP NO. 18A

For use on Door #(s):

124D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	315AN	IVE
1	EA	MANUAL FLUSH BOLT	FB458	BLK	IVE
1	EA	DBL CYL DEAD LOCK	L462T	622	SCH
2	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	FLUSH PULL	1115	622	TRI
2	EA	SURFACE CLOSER	4040XP HEDA	693	LCN

ALL OTHER HARDWARE BY DOOR MANUFACTURER

TOP FLUSHBOLT ONLY

PROVIDE 36" EXTENSION ROD FOR FLUSHBOLT

HARDWARE GROUP NO. 19

For use on Door #(s):

121A 121B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	PUSH PLATE	8200 8" X 16"	BLK	IVE
1	EA	PULL PLATE	8302 10" 6" X 16"	BLK	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	BLK	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	BLK	IVE
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 20

For use on Door #(s):

122 136 143

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
1	EA	STOREROOM LOCK	L9080T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	BLK	IVE

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 21

For use on Door #(s):

123

Provide each SL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	Sliding Door Hdwr	SD10-6.6 J STRAP	622	SCH
1	EA	POCKET DOOR LOCK	1074-2C -MERRYVALE SPEC		TRI
1	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11-948 36-083 36-082-037	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH

HARDWARE GROUP NO. 22

For use on Door #(s):

124A

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5	BBLK/ 622	IVE
2	EA	PANIC HARDWARE	CD-PA-AX-9850WDC-L-17-LBL-SNB	315	VON
2	EA	RIM CYLINDER	20-057 ICX	622	SCH
2	EA	MORTISE CYLINDER	20-061 ICX X K510-730 XQ11-948 36-083 36-082-037	622	SCH
4	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	SURFACE CLOSER	4040XP HCUSH TBWMS	693	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	BLK	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	MEETING STILE	155BK	BK	ZER
2	EA	DOOR BOTTOM	320AA	AA	ZER
1	EA	MEETING STILE	55BK	BK	ZER

PERIMETER SEAL BY FRAME MANUFACURER

HARDWARE GROUP NO. 23

For use on Door #(s):

124B

124C

Provide each FLD door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
1	EA	DOOR CONTACT	679-05HM	✓ BLK	SCE

ALL OTHER HARDWARE BY DOOR MANUFACTURER

****DOOR CONTACT TO BE PROVIDED BY DIVISION 28****

HARDWARE GROUP NO. 24

For use on Door #(s):

126

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5	BBLK/ 622	IVE
2	EA	MANUAL FLUSH BOLT	FB458	BLK	IVE
1	EA	DUST PROOF STRIKE	DP2	BLK	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	622	SCH
1	EA	FSIC CORE	23-030 EV29 T	622	SCH
2	EA	OH STOP	100S ADJ	BLK	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ TBWMS	693	LCN
1	EA	MEETING STILE	41BK	BK	ZER

PROVIDE 36" EXTENSION ROD FOR TOP FLUSHBOLT
CLOSER ON ACTIVE DOOR ONLY

HARDWARE GROUP NO. 25

For use on Door #(s):

001

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
ALL HARDWARE BY GATE MANUFACTURER					

HARDWARE GROUP NO. 26

For use on Door #(s):

002

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
ALL HARDWARE BY GATE MANUFACTURER					

Maintenance Materials, provide the following:

- As-built hardware schedule
- Copies of warranty information for each hardware type
- Binder of catalog cuts or complete catalog sections of items used, installation and maintenance/adjustment information.
- Collection of tools that were included with the hardware: wrenches, drivers, etc.

END OF SECTION

SECTION 08 71 13 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Exterior, automatic door operators, low energy, with visible header mounting.
- B. Automatic door operators shall be configured for doors as follows:
 - 1. Simultaneous pairs, same swing.

1.2 RELATED REQUIREMENTS

- A. Section 01 25 00 -Substitution Procedure: Administrative and procedural requirements for requesting approval of substitution.
- B. Section 01 30 00 – Administrative Requirements: Requirements for submittal procedures, project meetings, progress schedules, and documentation, reports, and coordination.
- C. Section 01 60 00 – Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- D. Section 01 81 13 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- E. Section 08 10 00 - Doors and Frames: Entrances furnished and installed separately.
- F. Section 08 40 00 - Aluminum-Framed Entrances, Storefronts and Curtain Walls: Entrances furnished and installed separately.
- G. Section 08 71 00 - Door Hardware: Hardware to the extent not specified in this Section.
- H. Division 26 00 00 – Electrical: Electrical connections provided separately including conduit and wiring for power to, and control of, automatic door operators.
- I. Division 28 00 00 - Electronic Safety and Security: Systems not specified in this section.

1.3 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- B. Knowing act: Consciously initiating the opening of power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.

1.4 REFERENCE STANDARDS

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
 - 2. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
- C. American Association of Automatic Door Manufacturers (AAADM).
- D. American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
 - 1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
 - 2. ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.
- E. American Society for Testing and Materials (ASTM):
 - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- F. California Department of Forestry and Fire Protection, Office of the State Fire Marshall (CSFM).
- G. International Code Council (ICC):
 - 1. IBC: International Building Code.
- H. International Standards Organization (ISO):
 - 1. ISO 9001 - Standard for Manufacturing Quality Management Systems.
 - 2. ISO 14025 - Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures.
 - 3. ISO14040 - Environmental Management -- Life Cycle Assessment -- Principles and Framework.
 - 4. ISO 14044 - Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines.
 - 5. ISO 21930 - Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services.
- I. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. Metal Finishes Manual for Architectural and Metal Products.
- J. National Fire Protection Association (NFPA):
 - 1. NFPA 101 - Life Safety Code.
 - 2. NFPA 70 - National Electric Code.
- K. Underwriters Laboratories (UL):

1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

L. United Nations Central Product Classification (UNCPC):

1. UNCPC 4212 - Product Category Rules for Preparing an Environmental Product Declaration for Power-Operated Pedestrian Doors and Revolving Doors.

1.5 COORDINATION

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices, electric door latching hardware, and security access control system. Refer to Division 28 00 00 - Electronic Safety and Security for systems not provided under this section.
- C. System Integration: Integrate automatic door operators with other systems as required for a complete working installation.
 1. Provide electrical interface control capability for activation of automatic door operators by security access system on doors with electric locking.
 2. Where indicated to install both knowing act and secure activation system, automatic door operators shall be configured to operate; by knowing act, after verification from secure activation system, when secured; by knowing act when not secured.
 3. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.
 4. Provide electrical interface with door latching hardware to enable exterior knowing act activation device only when latching hardware is dogged.

1.6 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Section 01 30 00 – Administrative Requirements: Submittal procedures.
- B. Action Submittals
 1. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
 2. Color Samples for selection of factory-applied color finishes.
- C. Information Submittals:
 1. Evaluation Service Reports: Based on evaluation performed by a qualified agency, for automatic entrance door assemblies.
 - a. Environmental Product Declaration.
 - b. Evaluation Report for compliance with IBC.

D. Sustainable Design Submittals

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

E. Closeout Submittals: Provide the following with project close-out documents.

1. Owner's Manual.
2. Warranties.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.

B. Qualifications

1. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
2. Manufacturer Qualifications: Qualified manufacturer with manufacturing facility compliant with ISO 9001.
 - a. Manufacturer shall have in place national service dispatch center providing 24 hours per day, 7 days per week, emergency call back service.

C. Certifications:

1. Automatic door operators shall be certified by manufacturer to meet performance design criteria in accordance with following standards:
 - a. ANSI/BHMA A156.10 and A156.19.
 - b. CSFM, Listed.
 - c. IBC.
 - d. NFPA 101.
 - e. **UL 325 Listed.**
2. Environmental Product Declaration (EPD): EPD for automatic door operators shall be certified by the manufacturer to comply with the following:
 - a. Prepared under Product Category Rule (PCR) UNCPC 4212.
 - b. Conform to ISO standards 14025, 14040, 14044, 21930.

- c. Life Cycle Assessment Basis: Cradle to Gate, minimum.

1.8 FIELD CONDITIONS

- A. Field Measurements: General Contractor shall verify openings to receive automatic door operators by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight, and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor Advise of any inadequate conditions or equipment.

1.9 WARRANTY

- A. Automatic door operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During warranty period Owner shall engage factory-trained technician to perform service and affect repairs. Safety inspection shall be performed after each adjustment or repair and completed inspection form shall be submitted to Owner.
- C. During warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
 - 4. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of

- the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
5. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria
- a. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation
 - c. Preference is given to product inventoried to at least 0.01% (100 ppm)
 - d. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher
 - e. Preference is given to Declare labels designated as Red List Free
6. Low-Emitting Materials criteria
- a. VOC content criteria
 - 1) For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. VOC emissions criteria or inherently non-emitting
 - 1) All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - a) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - b) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 AUTOMATIC DOOR OPERATORS

- A. Manufacturer: Stanley Access Technologies (www.stanleyaccess.com); M-Force™ Series automatic door operator.
1. Contact: Stanley Access Technologies, Juan Villanueva; Phone: 818-770-6165, Fax: 866-235-7984, Email: Juan.Villanueva@allegion.com.

- B. Substitutions: Refer to Section 01 25 00 Substitution Procedures.
- C. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.3 PERFORMANCE / DESIGN CRITERIA

- A. General: Provide automatic door operators capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).
- C. Opening-Force Requirements for Egress Doors: In event power failure to operator, swinging automatic entrance doors shall open with manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open door. Forces shall be applied at 1" (25 mm) from latch edge of the door.

2.4 REGULATORY REQUIREMENTS

- A. Power Operated Door Standard: ANSI/BHMA A156.19.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as required means of egress.

2.5 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Headers: 6063-T6.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Sheet and Plate: ASTM B 209.

2.6 COMPONENTS

- A. Header Case: Header case shall not exceed 6" (152 mm) square in section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. Operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by full-length removable cover, edge rabbeted to header to ensure flush fit. Removable cover shall be secured to prevent unauthorized access.

- B. Door Arms: Combination of door arms and linkage shall provide positive control of door through entire swing; units shall permit use of butt hung, center pivot, and offset pivot-hung doors.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- D. Signage: Provide signage in accordance with ANSI/BHMA A156.19.

2.7 SWINGING DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
 - 1. Operation: Power opening and spring closing.
 - 2. Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
 - 3. Handing: Non-handed; no tools required to change handing.
 - 4. Capacity: Rated for door panels weighing up to 700 lb (318 kg).
 - 5. Mounting: **Visible**.
 - 6. Features:
 - a. Adjustable opening and closing speeds.
 - b. Adjustable opening and closing force.
 - c. Adjustable back-check.
 - d. Adjustable hold-open time between 0 and 30 seconds.
 - e. Reverse on obstruction.
 - f. Time delay for electric lock integration.
 - g. Force compensation and closed loop speed control with active braking and acceleration.
 - h. Power Close.
 - i. Slam Protection.
 - j. Power Assist.
 - k. Lock Release.
 - l. Stall Sensor Ignore.
 - m. Electronic Coordination.
 - n. Optional Switch to open/Switch to close operation.
 - o. Optional push to activate operation.
 - p. Fire alarm interface, configurable to safely open or close doors on signal from fire alarm system.
- C. Field Adjustable Spring Closing Operation: Operator shall close the door by spring energy employing motor, as dynamic brake to provide closing speed control. Closing spring shall be helical compression spring, adjustable for positive closing action. Spring shall be adjustable, without removing operator from header, to accommodate wide range of field conditions.

- D. Independent Adjustable Closing and Latching Speed Control: Operator shall employ rheostat module to allow for independent field adjustment of closing and latching speeds using motor as a dynamic brake.
- E. Field Adjustable Open Stop: Operator shall provide field adjustable open stop to accommodate opening angles from 80 to 135 degrees without need for additional components.
- F. Consistent Cycle: Operator shall deliver even, consistent open manual push force across entire transition from door fully closed to door fully open. Additionally, force shall be field adjustable to accommodate wide range of on-site conditions.
- G. Quiet Performance: Operator shall be designed to output audible noise ratios less than or equal to 50dba.
- H. Manual Use: Operator shall function as a manual door closer in direction of swing with or without electrical power. Operator shall deliver even, consistent open force across entire transition from door fully closed to door fully open.
- I. Electrical service to door operators shall be provided under Division 26 00 00 – Electrical. Minimum service to be 120 VAC, 5 amps.

2.8 ELECTRICAL CONTROLS

- A. Electrical Control System: Electrical control system shall include microprocessor controller and high-resolution position encoder. Encoder shall monitor revolutions of operator shaft and send signals to microprocessor controller to define door position and speed.
 - 1. High-resolution encoder shall have resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
 - 2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
- B. Performance Data: Microprocessor shall collect, and store performance data as follows:
 - 1. Counter: Non-resettable counter to track operating cycles.
 - 2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
 - 3. LED Display: Display presenting current operating state of controller.
- C. Controller Protection: Microprocessor controller shall incorporate following features to ensure trouble free operation:
 - 1. Automatic Reset Upon Power Up.
 - 2. Main Fuse Protection.
 - 3. Electronic Surge Protection.
 - 4. Internal Power Supply Protection.
 - 5. Resettable sensor supply fuse protection.
 - 6. Motor Protection, over-current protection.

- D. Power Close: When enabled, engages the operator to close a door that does not close completely at the end of a cycle.
- E. Force Compensation: Utilizing the closed loop speed control, the operator shall maintain constant opening and closing speeds when subjected to excessive outside forces, such as positive or negative stack pressures.
- F. Slam Protection: Operators speed control system prevents door from slamming at full open or full closed position.
- G. Power Assist: Operator mode that lowers opening forces when door is used manually. Power assist is active only while pushing or pulling door. Door will close when opening force is no longer applied.
- H. Lock Release: On doors with electric locking, operator shall include closing function to release tension on latch mechanism prior to opening the door.
- I. Stall Sensor Ignore: Adjustable setting to disable swing side safety sensors at specific angle.
- J. Electronic Coordination: On pairs of doors, allows independent timing of opening and closing of each leaf as required for astragal coordination.
- K. Soft Start/Stop: "Soft-start" "soft-stop" motor driving circuit shall be provided for smooth normal opening and recycling.
- L. Obstruction Recycle: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle.
- M. Programmable Controller: Microprocessor controller shall be field programmable.
 - 1. The following parameters may be adjusted:
 - a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
 - b. Adjustable and variable features specified.
 - 2. Manual programming shall be available through local interface which has two-digit display with selection control including three push buttons.
- N. Emergency Breakout Switch: Cam actuated emergency breakout switch shall be provided to disconnect power to motor when in-swinging door is manually pushed in emergency out direction. Operator will then automatically reset, and power will be resumed.
- O. Control Switch: Automatic door operators shall be equipped with three-position function switch to control operation of door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.

- P. Power Switch: Automatic door operators shall be equipped with two position On/Off switch to control power to the door.

2.9 ACTIVATION DEVICES

- A. Secure Activation: Secure activation device provided by other as specified in Division 28 00 00 – Electronic Safety and Security.
- B. Push Plates: Provide 4 ½ inch (114 mm) square push plates with UL recognized SPDT switch. Face plates and mounting studs shall be stainless steel. Face plates shall be engraved with international symbol for accessibility and “Push To Open”.
 - 1. Push plates shall be wall mounted in single or double gang electrical boxes and hardwired to door operator controls.
 - 2. Push plates shall be similar to or better than BEA 10PBS451.

2.10 ALUMINUM FINISHES

- B. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.
- C. Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
 - 1. AAMA 607.1
 - 2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.

2. Set headers, arms and linkages level and true to location with anchorage for permanent support.

- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 00 00 – Electrical.

3.3 FIELD QUALITY CONTROL

- A. Testing Services: Factory Trained Installer shall test and inspect each swinging automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

3.4 REPAIR

- A. Repair damaged finish to match original finish.

3.5 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in specified ANSI/BHMA operating standard by AAADM Certified Technician.

3.6 CLEANING

- A. Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances.

END OF SECTION 08 71 13

SECTION 08 81 00 – GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Annealed glass.
2. Strengthened glass.
3. Coated glass.
4. Laminated glass.
5. Insulating glass units.
6. Delegated design of glazing.
7. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. GANA: Glazing Association of North America.
2. IGCC: Insulating Glass Certification Council.
3. IGMA: Insulating Glass Manufacturers Alliance.
4. IGU: Insulating Glass Unit.
5. NGA: National Glass Association.
6. PVB: Polyvinyl Butyral.
7. SGCC: Safety Glazing Certification Council
8. SIGMA: Sealed Insulating Glass Manufacturers Association.

B. Definitions:

1. Manufacturer: Means the glass manufacturer, unless otherwise indicated.
2. Fabricator: Means the glass fabricator, unless otherwise indicated.
3. Failure: Includes material deterioration beyond normal weathering, coating degeneration, the development of defects not attributed to glass breakage or to maintaining and cleaning coated glass contrary to the manufacturer or fabricator instructions, failure of a IGU hermetic seals, and failure of glazing sealants or gaskets to remain watertight and airtight.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate IGU spacer finish with all finishes of framing into which IGUs are installed.
- B. Delegated Design Requirements:
 - 1. Engineer, fabricate, assemble, and install glazing that conforms to the sizes and thicknesses indicated and other Contract Document requirements; meets specified performance requirements; and results in structurally sound and weathertight assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
 - 2. Maintain visual design concept indicated, including sizes and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.
- C. Performance Requirements:
 - 1. General: Installed glass glazing must establish and maintain a continuous watertight seal without failure.
 - 2. Design Pressure: Calculate in conformance with American Society of Civil Engineers/ Structural Engineering Institute publication ASCE/SEI 7, *"Minimum Design Loads and Associated Criteria for Buildings and other Structures"*.
 - 3. Load Resistance: Provide glazing materials conforming to ASTM E 1300.
 - 4. Differential Shading: Accommodate, resist, distribute, or transfer thermal stresses induced by differential shading within individual glass lites.
 - 5. Glass Thickness: Thicknesses indicated are estimates; determine actual required thicknesses. Overall thickness of each glass type and composite thickness of multiple-layer glass types must be consistent throughout the project.
 - a. Minimum thicknesses must be such that the probability of breakage at design pressure does not exceed 8 lights per 1,000 lights (SF 2.5), based on a 3-second gust wind load duration and the reflectance and shading indicated.
 - b. Exterior glass thickness must be at least 6.0mm (nominal 1/4-inch).
 - 6. Minimum Glass Bite Depth: At least 3/8-inch glass bite depth for 6mm (nominal 1/4-inch) monolithic lites, and 1/2-inch for 12mm (nominal 1/2-inch) laminated glass and 25mm (nominal one-inch) IGUs, unless otherwise indicated.
 - 7. Minimum Edge Clearance: At least 1/4-inch for 6mm (nominal 1/4-inch) monolithic lites, 12mm (nominal 1/2-inch) laminated glass, and 25mm (nominal one-inch) IGUs, unless otherwise indicated.
 - 8. Minimum Face Clearance: At least 1/8-inch for 6mm (nominal 1/4-inch) monolithic lites and 12mm (nominal 1/2-inch) laminated glass, and 3/16-inch for 25mm (nominal one-inch) IGUs, unless otherwise indicated.
 - 9. Safety Glazing Requirements: Provide either laminated glass or fully tempered glass conforming to ANSI Z97.1 requirements for Drop Height Class A wherever safety glazing is indicated or required. Wire glass is prohibited.
 - 10. Other Requirements: Installed glass must be free from rattle.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 - 2. Glazing Schedule: Submit glazing schedule indicating glazing types, locations, sizes, thicknesses, and extents.
 - 3. Samples: Submit at least 8-inch square representative samples of each glass and fabricated glass assembly type, color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; analysis of supporting construction, including section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Glazing must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.

B. Safety Glazing Certification:

1. Each pane of safety glass delivered to the project site must be furnished with a permanent identification label or mark that identifies the labeler and indicates that safety glazing material is utilized for the installation. Each label must be permanently affixed in a location such that the label remains visible after the pane of glass is installed.
2. Each pane of tempered glass delivered to the project site must be furnished with a permanent identification label or mark etched or ceramic-fired onto the glass surface that identifies the manufacturer or fabricator and indicates that tempered glass is utilized for the installation. Each label or mark must be permanently affixed in a location such that the label or mark remains visible after the pane of glass is installed.

C. Insulating Glass Certification:

1. Each insulating glass unit delivered to the project site must be furnished with a permanent certification label issued by the Insulating Glass Certification Council (IGCC) (which assures quality and performance of sealed insulating glass products) or the National Accreditation and Management Institute (NAMI) (which assures the buyer that the purchase product is the same product that was tested by an independent laboratory, and performs to the level that the test report reflects) that identifies the labeler and indicates the performance of sealed insulating glass units

utilized for the installation; each label must be permanently affixed in a location such that the label remains visible after the glass unit is installed.

D. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing glazing installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Fabricator: Company or individuals must have at least 10 years' experience fabricating glazing installed on at least 100 previous projects similar to this project in size, material, design, and complexity.
3. Installer: Company or individuals must have at least 5 years' experience installing glazing for at least 30 previous projects similar to this project in size, material, design, and complexity.
4. Supervisors: Individuals must have at least 7 years' experience installing glazing for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading glazing installers.
5. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

E. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate glazing into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.

- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective glass with undamaged new glass that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 10 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 5 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:

- a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 PRIMARY GLASS MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Guardian Industries Corp.
 - 2. Pilkington North America, Inc.
 - 3. PPG Industries.
 - 4. Saint-Gobain Corp.

2.3 MANUFACTURED GLASS

- A. Clear Annealed Vision Glass:
 - 1. Description: ASTM C 1036, Type I (transparent flat glass), Class 1 (clear), Quality Q3 (select glazing applications).
- B. Ultra-Clear (Low Iron) Annealed Vision Glass:
 - 1. Description: ASTM C 1036, Type I (transparent flat glass), Class 1 (clear), Quality Q3 (select glazing applications).
 - 2. Products: Provide one of the following, or equal.
 - a. "UltraWhite" manufactured by Guardian Industries Corp.
 - b. "OptiWhite" manufactured by Pilkington North America, Inc.
 - c. "Starphire" manufactured by PPG Industries.
 - d. "DIAMANT" manufactured by Saint-Gobain Glass.
 - 3. Performance Requirements:
 - a. Visible Light Transmittance (VLT): At least 90 percent at 6mm thickness.

2.4 SECONDARY GLASS FABRICATORS

- A. Fabricators: Provide products fabricated by one of the following, or equal.
 - 1. Oldcastle BuildingEnvelope Corp.
 - 2. PPG Industries.
 - 3. Viracon, Inc.

2.5 FABRICATED GLASS

- A. Fully-Tempered (Toughened) Glass:
 - 1. Description: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent flat glass), Class 1 (clear), Quality Q3 (select glazing applications).
 - 2. Minimum Surface Compression Strength: At least 10,000 pounds per square inch.

3. Fabrication:
 - a. Fabricate tempered glass by the horizontal (roller hearth) process with roll wave distortion parallel to the bottom glass edge when installed, unless otherwise indicated.
 - b. Glazing materials must be free from bubbles, smoke vanes, air holes, scratches and other defects, having ground and arrised edges; provide polished edges where exposed.
4. Source Quality Control:
 - a. Individual tempered glass lites installed overhead and floor-to-ceiling tempered glass lites installed adjacent to walking surfaces must be fully heat soak tested by the manufacturer or fabricator before delivery to the project site.
 - b. Other tempered glass lites may have statistical heat soak testing performed to demonstrate nickel sulfide breakage does not exceed 0.1 percent.

B. Insulating Glass Units:

1. Description: ASTM C 2190.
2. Glass Panes: Indicated on the Drawings or selected by the Architect, or equal.
3. Interspace: Hermetically sealed air-filled interspace.
 - a. Spacer Material: Mill finish aluminum.
 - b. Spacer Corner Construction: Provide spacers and splices with no visible seams; and with soldered/welded corners.
 - c. Desiccant: Either molecular sieve or silica gel, or a blend of both, provided on all four sides.
4. Seals: Black polyisobutylene primary sealant; black silicone secondary sealant.
5. Edge Deletion: To promote full adhesion of primary sealant, low "E" coatings at the glass perimeter must be removed before fabrication, as required, recommended, authorized, sanctioned, or accepted by the manufacturer.
6. Fabrication: IGU assemblies conforming to IGMA publication TB-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use".

2.6 ACCESSORIES

- A. Spacer Shims: Continuous shims fabricated from load-bearing, non-leaching, high-impact polystyrene.
- B. Setting Blocks: Elastomeric silicone rubber conforming to ASTM C 1115, CH9.
- C. Setting Blocks, Spacers and End Blocks: Provide the following, unless another type, hardness, class, or surface is supplied, required, recommended, authorized, sanctioned, or accepted by the glass installer.
 1. Setting Blocks: Elastomeric silicone rubber conforming to ASTM C 1115, CH9.
 2. Spacers for Structural Silicone Glazing: Elastomeric silicone rubber conforming to ASTM C 1115, CH6S1.

- D. Glazing Gaskets: Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
 - 1. Firm, Dense Gaskets: Elastomeric silicone or EPDM rubber conforming to ASTM C 1115, CH7S2 unless another type, hardness, class or surface is supplied, required, recommended, approved, or accepted by the glass installer.
 - 2. Soft, Closed Cell Gaskets: ASTM C 509. Provide silicone or EPDM rubber with pre-molded corners.
- E. Backer Rod for Butt Joints: Square bi-cellular backer rod; color matching silicone sealant.
- F. Cleaners, Primers, Sealers: Supplied, required, recommended, or accepted by the manufacturer or fabricator.
- G. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install glazing using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set glazing true to line; plumb, level, and square without warp or rack; with flush, well-fitted joints; and in alignment with adjacent construction.

3. Completed work must match approved samples and mockups, as accepted by the Architect.
 4. Installed glazing must be warrantable. Do not install, correct, or replace glazing in a manner that is un-warrantable by the manufacturer; or that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach glazing to supporting construction.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible glazing surfaces in a manner that does not result in any warranty or guarantee becoming void. Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed glazing in place from deterioration and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed glazing unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed glazing surfaces as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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DIVISION 09

FINISHES

SECTION 09 05 16- PREPARATION OF CONCRETE SUBSTRATES FOR FINISH FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete substrate testing equipment.
2. Corrective (remedial) MVECS.
3. Surface preparation.
4. Site tests and inspections.
5. Supplementary components, accessories, and detail work normally furnished or otherwise necessary for complete testing and preparation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for preventative (day-of-pour) MVECS; for definitions of the term "recently-cured", "hardened", "newly-aged", and "existing" concrete; and for wet concrete RH meter accessories.
3. Section 03 54 16 for definition of the term "underlayment".
4. Section 09 29 00 for definition of "permanent enclosure".

1.2 RELATED DOCUMENTS

A. This specification section

1. supplements the requirements of specification sections that identify penetrants, overlays, and coverings required for the project; and
2. is used with other specification sections to produce correct and complete substrates for all actual in-service flooring conditions applicable to the project; and sound substrates for the proper and warrantable installation of all specified or selected penetrants, overlays, and coverings, including underlayment specified in Section 03 54 16.

1.3 PRICE AND PAYMENT PROCEDURES

A. Slab Remediation:

1. Without reimbursement from Owner, perform or arrange and pay costs for performing all remedial work necessary to correct and improve

- a. defective flatwork, including areas that exceed the MVER, pH, and RH limits required, recommended, or accepted by the penetrant, overlay, and covering manufacturers; and
 - b. penetrant, overlay, and covering failures resulting from selected concrete curing methods; and coordination of, or failure to coordinate, the chemical and adhesive compatibility of selected curing compounds with all subsequent penetrants, overlays, and covering materials, including primers, adhesives, and sealants, and other installation materials.
 2. For other applications, specified MVECS is excluded from the Contract and used only as a topical remediation where necessary to conform to the penetrant, overlay, and covering manufacturers' MVER, pH, and RH requirements.
- B. Unit Prices:
1. Administrative Requirements:
 - a. Supply unit prices in terms of dollars per square foot for complete MVECS surface preparation and installation.
 - b. Specified MVECS becomes part of the Contract upon acceptance in writing by the Owner via properly-executed Change Order.
 2. Measurement Procedures: Contract adjustments are made based on the net installed verifiable quantities of conforming work compared to quantities indicated on the Drawings.
 3. Payment Procedures:
 - a. The Owner provides payment based on actual quantities and measurements that are both placed in the work and verified by the Architect.
 - b. The Owner is not required to provide additional compensation for extraneous, non-conforming, or rejected work.
- C. Alternates: With input from the preventative (day-of-pour) MVECS manufacturer, preventative MVECS specified in Section 03 35 10 may be considered for certain concrete curing applications in lieu of curing compounds; and possibly in lieu of corrective MVECS products specified in this specification section.

1.4 REFERENCES

- A. Abbreviations and Acronyms:
1. CC: Anhydrous Calcium Chloride.
 2. ICRI: International Concrete Repair Institute.
 3. MVECS: Moisture Vapor Emission Control System.
 4. MVER: Moisture Vapor Emission Rate.
 5. pH: Potential of Hydrogen.
 6. RH: Relative Humidity.
- B. Definitions:
1. Floor Preparation: Means to make flatwork surfaces ready to receive finish flooring and suitable for proper bonding of flooring and installation materials, including

patching minor holes and saw cuts, sanding, sweeping, and cleaning of conforming substrates.

2. Floor Repair: Means to fix or mend non-conforming substrates suffering from damage or fault, including grinding, filling, topping, and leveling activities.
3. Moisture Vapor Emission Rate (MVER): Means the amount of moisture emitted from a substrate, expressed as the weight of condensed gas (liquid) in theoretical pounds emitted over 1,000 square feet of floor area during a 24-hour period. MVER is commonly referred to as "pounds" (i.e., "3 pounds" or "3 lb"). Rates range from 0 to 30 pounds per 1,000 square feet per 24 hours.
4. Substrate: Means a recently-cured, hardened, newly-aged, or existing concrete substrate, including cast-in-place, sitecast, and precast concrete floor and deck assemblies, cast underlayment, toppings, repair materials, and similar items.
 - a. Floor: Means a slab-on-grade floor assembly.
 - b. Deck: Means a suspended floor or roof slab assembly.
5. Penetrant: Means any direct-applied material, product, component, accessory, or other item that can pass into or through substrate surfaces, or enter and diffuse through substrate surface cracks, pores, and other surface defects. Penetrants include water, hardeners, curing compounds, stains, penetrating repellents and sealers, non-sacrificial graffiti-resistant materials, and dry penetrants.
6. Overlay: Means any direct-applied film-forming or high-build material that covers a substrate surface, including cast decks, underlayment, and toppings; dampproofing, waterproofing, and roofing; liquid flashings and sealants; fluid-applied and flooring treatment; terrazzo flooring; and paints, coatings, and film-forming sealers; and sacrificial graffiti-resistant materials.
7. Covering: Means any direct-applied material, product, component, accessory, or other item that is adhered or bonded to a substrate surface, including tile and adhered veneer assemblies; specialty, masonry, wood, resilient and precast terrazzo flooring; carpeting; and unit paving.
8. Cladding: Means any material, product, component, accessory, or other item supported by a framework, which is attached to a sporting construction, including anchored veneer, wall and soffit panels, and exterior plaster assemblies; suspended ceiling assemblies; and free-standing elevated accessible floor and roof paver assemblies.
9. Overburden: Means all materials, components, accessories, and other items installed or placed over a cured substrate, including overlays, coverings, cladding, and vegetated plaza deck and roof assemblies.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:

1. MVECS manufacturer's representative and MVECS installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, penetrant, overlay and covering manufacturers' representatives and

installers, the MVECS manufacturer's representative and installer, and the entities and individuals responsible for conducting concrete substrate testing.

3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
4. During the meeting, review
 - a. substrate design and installation, including concrete mix design, water-cement ratio, slab thickness at each test location, below grade VDRs and concrete placement and pour dates;
 - b. curing, sealing, or bond breaking compounds used on substrates, along with requirements and techniques used for complete removal of compounds prior to testing and floor covering installation;
 - c. trenching, including mix design, water-cement ratio, thickness, and pour dates of concrete or slurry backfill;
 - d. bonding agents selected for overlay installation or application;
 - e. primers and adhesives selected for covering installation;
 - f. qualifications of the testing agency and testing agency personnel that are scheduled to complete testing, and that interpret test results;
 - g. calibration and verification of test equipment prior to beginning each round of testing;
 - h. HVAC system operation and requirements during testing, including temperature and RH limits;
 - i. preparation of testing sites, including procedures to assure slab surfaces are free from any material or substance that may hinder the free release of moisture from the slab;
 - j. testing procedures and sequence for each test, including sequence, frequency, and location of test sites;
 - k. requirements for testing and inspection reports;
 - l. the construction schedule;
 - m. temporary procedures required to protect concrete surfaces from re-wetting after initial testing; and
 - n. redistribution of moisture within the substrate after floor coverings are applied;
5. Identify and discuss adverse or unfavorable conditions detrimental to testing and floor preparation.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

B. Quality Standards:

1. Quality Guideline: Selected concrete surface profiling, preparation, cleaning, and repair must conform to the requirements of International Concrete Repair Institute (ICRI) Guideline No. 310.2R, *"Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair"*.

2. Installation Standard: Concrete surface preparation must conform to the requirements of Journal of Protective Coatings and Linings (JPCL) publication, *"Surface Preparation of Concrete Substrates"*.
- C. Qualifications:
1. Substrate Testing: Individuals performing substrate testing must be certified as ICRI Concrete Slab Moisture Testing Technicians, Grade 1 and current in their certification.
 2. Substrate Repair: Individuals performing substrate repair must be certified as ICRI Concrete Surface Repair Technicians, Grade 1 and current in their certification.
- D. Sequencing: Begin substrate testing only after
1. the building is enclosed with a permanent enclosure, including permanently-installed doors, windows, storefronts, curtain walls and similar opening protectives;
 2. "wet work" such as concrete work, plastering, tile installation, and gypsum board finishing are complete and cured and dried to a condition of equilibrium;
 3. testing areas are properly prepared for testing; and
 4. the HVAC system is activated, operating, and maintaining temperatures and RH at anticipated occupancy levels for at least 48 hours prior to and during testing.
 - a. If HVAC activation and operation prior to testing cannot be provided within the proposed construction schedule, then close a number of rooms or spaces where conditions can either be brought to anticipated normal conditions or into conformance with the minimum environmental parameters of the specified test standards using commercial equipment and building climate control services.
 - b. Provide a recording hygrometer to monitor and record ambient temperature and RH levels for comparison to design occupancy conditions.
- E. Scheduling:
1. Allow sufficient time in the construction schedule to permit concrete to cure and dry, without being re-wetted, for at least 90 days before beginning testing. Substrates re-wetted after initial curing must be permitted to cure and dry for at least 180 days before beginning testing.
 - a. If minimum concrete curing and drying time cannot be provided in the construction schedule, assume the specified MVECS must be incorporated into the project as a topical remediation for concrete substrates, and reflect this assumption in the project cost until otherwise directed by the Owner.
 - b. Forced drying substrates is prohibited.
 2. Allow sufficient time in the construction schedule to permit RH test sites to equalize for at least 72 hours prior to reading equilibrium RH levels.
 3. Testing must be complete and reports submitted at least one week, but not more than 3 weeks, before beginning penetrant, overlay, or covering installation or application.

1.6 SUBMITTALS

- A. Action Submittals: Before beginning the work of this specification section, including bulk purchase and delivery of products, submit to the Architect the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. Submit a comprehensive and complete list of proposed and other items specified, required, or otherwise necessary to complete the work of this specification section, including all accessories and similar secondary items normally furnished, required, or otherwise necessary for complete repair, surface preparation, testing, and remediation.
 - b. For each item listed, submit manufacturer's product data, specifications, typical installation details for all actual in-service conditions applicable to this project, and any other information necessary to demonstrate conformance with the Contract Documents, excluding Material Safety Data Sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review.
- B. Informational Submittals: Submit to the Architect the following for information (for informal review: responsive action by the Architect, including formal review and approval, is not expected or required, except to record non-conformance with specified requirements).
 - 1. Installation Instructions: Before beginning the work of this specification section, submit the following.
 - a. Submit manufacturer-prepared published instructions for the proper installation of each furnished manufactured item and accessory, including packaging, delivery, storage, handling, surface preparation, installation, adjusting, cleaning, and protection instructions and requirements.
 - b. If manufacturer-prepared published installation instructions are either unavailable or do not specifically apply to actual project conditions, then consult with the manufacturer's representative and obtain manufacturer-prepared, project-specific supplemental instructions printed on the manufacturer's company letterhead. Promptly distribute copies to the Architect for examination before beginning the work of this specification section; the Architect may have comments that lead to contract modifications, or to minor changes in the work.
 - 2. Test Reports: Submit facility floor plan diagrams showing area calculations and locations of each test along with measured test results for each test location.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.

- a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 1. American Moisture Test, Inc.

2. Vaisala
3. Wagner Electronics.

2.3 CONCRETE SUBSTRATE TESTING EQUIPMENT

- A. Description: Commercially produced and -packaged test kits and equipment delivered to testing sites in factory-sealed wrappings.
- B. MVER Testing Kits (CC Moisture Test Kits):
 1. Description: ASTM F 1869-compliant anhydrous calcium chloride moisture vapor testing kits consisting of a sealed dish of anhydrous calcium chloride, a metering dome with gasket, and instructions.
 2. Product: "AMT Calcium Chloride Moisture Test Kit" manufactured by American Moisture Test, Inc., or equal.
 3. Components:
 - a. Non-pre-weighed, non-recycled, 94-percent pure anhydrous calcium chloride sealed in air-tight dishes.
 - b. Virgin resin non-recycled plastic dome having a maximum U.S. perm rating of 0.10-perm or less.
 - c. Butyl adhesive sealant system.
 - d. Dish container size of 69mm plus or minus one millimeter; calcium chloride weight of 16 grams plus or minus one gram.
- C. pH Testing Kits:
 1. Description: ASTM F 710-compliant digital alkalinity-pH meter.
 2. Product: "AMT Concrete Digital Alkalinity-pH Meter" manufactured by American Moisture Test, Inc., or equal.
 3. Components:
 - a. Meter must return wide range (1-14) pH readings.
 - b. Provide clean distilled or deionized water.
- D. RH Testing Equipment:
 1. Description: ASTM F 2170-compliant temperature and RH meter, cable, RH probes, and concrete sleeves.
 2. Product: "AMT RH System" manufactured by American Moisture Test, Inc., or equal.

2.4 CORRECTIVE (REMEDIAL) MVECS

- A. Description: Corrective MVER remediation system consisting of concrete mechanical surface profiling, sealer, and cementitious covering.
- B. Application: MVER remediation system are applied when test results indicate slab MVER, pH, or RH exceed selected coating or covering manufacturer's required, recommended, or accepted limits.

- C. Concrete Surface Profiling: ICRI concrete surface profile CSP 2 to CSP 3 (grind to light blast between 4 and 10 mils), unless otherwise explicitly required, recommended, accepted in writing by the sealer manufacturer.
- D. Sealer:
 - 1. Description: Moisture seal applied to substrates as a topical remediation.
 - 2. Products: "MES 100" manufactured by Floor Seal Technology, Inc., or equal.
 - 3. Requisite Properties:
 - a. Composition: Products may not contain latex, organic additives or chemistries that have a potential to either re-emulsify or support micro-organism growth.
 - b. Growth Resistance: Product must not support the growth of mold, mildew or biological growth.
 - c. Safety: Non-corrosive, non-toxic, and non-hazardous to installers.
 - d. Water Pollution: Product must be a non-marine pollutant, and safe for natural water sources.
 - e. Maximum VOC Material Content: Less than 100 grams per liter.
 - 4. Performance Requirements:
 - a. Water Vapor Transmission: Products must bring emission rates of up to 20 pounds to within a range conforming to the flooring manufactures' requirements, when measured in conformance with ASTM F 1869.
 - b. Alkali Resistance: Tolerant to 14pH alkali exposure, when tested in conformance with ASTM D 1308 and ASTM F 710.
 - c. Minimum Adhesion Strength: Between 370 and 500 pounds per square inch, when tested in conformance with ASTM D 4541.
 - d. Adhesive Compatibility: Complete compatibility with all covering primers, adhesive, and materials.
 - e. Minimum RH Tolerance: Tolerant to at least 95 percent RH exposure, when determined in conformance with ASTM F 2170.
- E. Covering:
 - 1. Description: Cementitious topping applied directly over sealer to provide smooth substrate for finish flooring.
 - 2. Products: Hydraulic cement underlayment specified in Section 03 54 16.
 - 3. Minimum Thickness: Install underlayment to thickness required by either the sealer manufacturer or the finish flooring manufacturer (whichever is thicker), but not less than 1/8-inch.

2.5 ACCESSORIES

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16 unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Other Accessories: Provide accessories and other similar secondary items supplied, required, recommended, or accepted by the MVECS manufacturer.

2.6 SURFACE PREPARATION

A. Penetrants:

1. Remove all dirt, dust, debris, and other foreign matter from concrete surfaces

B. Marker Removal:

1. Remove all slab markings by sanding or bead blasting surface clean.
2. Completely remove all marker markings (i.e. Sharpie markers), marker paint, spray paint, and other markings.

C. Floor Coatings and Fluid-Applied Flooring:

1. Provide one or more of the following ICRI concrete surface profiles, as applicable, unless otherwise explicitly required, recommended, or accepted in writing by the flooring manufacturer.
 - a. Sealers: CSP 1 to CSP 2. (grind to between 0 and 3 mils)
 - b. Thin-Film Coatings: CSP 2 to CSP 3. (grind to light blast between 4 and 10 mils)
 - c. High-Build Coatings and Resurfacing Applications: CSP 3 to CSP 5. (light to medium shotblast between 10 and 40 mils)
 - d. Self-Leveling Overlays: CSP 4 to CSP 6. (medium to heavy shotblast between 50 mils and 1/8-inch)
 - e. Polymer Overlays: CSP 5 to CSP 9. (medium shotblast to coarse planing between 1/8- and 1/4- inch)
 - f. Concrete Overlays, Toppings, and Repairs: CSP 5 to CSP 10. (medium shotblast to coarse planing greater than 1/4- inch)
2. To reduce the risk of introducing microcracking into the substrate, all concrete surface profiling must be achieved through abrasive blasting, grinding, or shot blasting; or through the use of surface retarders specified in Section 03 35 10.
 - a. Handheld concrete breakers, rotomilling, needle scaling, scabbling, and scarifying are prohibited, unless explicitly required or recommended in writing by the covering manufacturer (scarifying grooves/lines may become visible through a newly laid coverings).
 - b. Ultra-high- and high-pressure water jetting, and low-pressure water jetting surface preparation methods are also prohibited.
 - c. Chemical cleaning and acid etching are also prohibited. (residual chemicals not removed may adversely affect the flooring performance and adhesion – ASTM D 4262 covers procedures for determining the acidity or alkalinity of concrete surfaces prepared by chemical cleaning or etching prior to coating)
3. Repair damaged sub-floor. Produce a uniform and smooth substrate. Fill cracks, holes, depressions, and similar substrate defects with trowelable leveling and patching compound; remove bumps and ridges.
4. Sweep and vacuum-clean substrates just prior to beginning floor covering installation.
5. Move floor coverings and installation materials into spaces at least 48 before installation.

- D. Floor Coverings: Prepare substrates in conformance with the requirements of ASTM F 710 and as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
1. Verify substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives or that contain soap, wax, oil, or silicone; or that may negatively affect the quality of installation, durability, appearance, or performance of furnished flooring. Comply with the flooring manufacturers' instructions using manufacturer-recommended techniques and equipment. Do not use solvents.
 3. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface. Prohibit traffic until patching compound is cured.
 4. Repair damaged sub-floor. Produce a uniform and smooth substrate. Fill cracks, holes, depressions, and similar substrate defects with trowelable leveling and patching compound; remove bumps and ridges.
 5. Sweep and vacuum-clean substrates just prior to beginning floor covering installation.
 6. Do not install floor coverings until both they and the installation materials are acclimated to the same temperatures as the spaces into which they are installed. Move floor coverings and installation materials into spaces at least 48 before installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Before beginning testing, examine project conditions and field-verify measurements affecting the work of this specification section.
1. Examine substrates scheduled for testing, and other conditions under which such items are tested, including HVAC operation and building enclosure.
 2. Verify that work performed as part of the work of other specification sections conforms to the testing equipment or testing kit manufacturer's requirements; and satisfies all other conditions relating to the quality of testing.

3.2 FIELD QUALITY CONTROL

- A. Site Tests and Inspections:
1. General: Include site tests and inspections as part of the work of this specification section. The Owner's testing and inspection agency performs tests and inspections.
 - a. Schedule and arrange all tests and inspections.
 - b. Coordinate all work and the final construction schedule with all tests and inspections.

- c. Coordinate tests and inspections with the work of other specification sections, and other specified, required, or necessary tests and inspections.
 - d. Furnish all work, equipment, tools, facilities, personnel, and controls necessary for each test and inspection.
 - e. Arrange tests and inspections by notifying the Owner, the testing and inspection agency, the installer, the manufacturer's representative, and the Architect at least 5 business days before work is ready for testing or inspection.
 - f. Witness all site tests and inspections.
 - g. Receive test and inspection reports and distribute to the installer and the manufacturer's representative.
 - h. When tests and inspections reveal defective items, repair defective work to the satisfaction of the manufacturer's representative and Architect, and re-test and re-inspect work without reimbursement from Owner until all work passes tests and inspections.
2. Required Tests: Conduct the following tests on all concrete substrates prior to the installation of any flooring material or component regardless of substrate grade level or age.
- a. MVER Testing (Anhydrous Calcium Chloride Test): Conduct CC tests in conformance with ASTM F 1869.
 - 1) Test area environmental conditions must match that of the finished floor covering.
 - 2) Doors, windows, and roofing must be installed and the building temperature controlled to a finished building atmosphere.
 - 3) Do not perform tests when the interior building temperature is below 65 deg. F for 72 hours prior to and throughout the duration of testing.
 - 4) The minim required number of test kits is determined by the square footage of areas scheduled to receive finish flooring. Provide at least 3 test kits for the first 1,000 square feet, and at least one additional test kit for each additional 1,000 square feet or fraction thereof, with consideration given to separation of test areas.
 - 5) Time of exposure must be between 60 hours 72 hours.
 - 6) Clean substrate in area to be tested by removing dust solvent, paint, wax, oil, grease, residual adhesive, adhesive removers, curing, sealing, hardening, or parting compounds, alkaline salts, excessive carbonation, or laitance, mold mildew and other foreign materials.
 - 7) Weigh the tape sealed dish on a gram scale with 1/10th gram gradation. Record start weight, date and time on dish's label and instruction document.
 - 8) Unseal dish and expose test according to preprinted test kit instructions.
 - 9) After exposure time has elapsed, retrieve test dish re-seal and re-weigh according to the manufacturer's instructions.
 - 10) Moisture emission rates exceeding 3 pounds may affect coating or covering. Verify permissible RH levels with individual flooring manufacturers.
 - b. Alkalinity (pH) Testing: Conduct pH test in conformance with ASTM F 710.
 - 1) Perform tests after abrasive removal of concrete surfaces.

- 2) Place several drops of water on a clean portion of the substrate surface; form a puddle approximately one-inch in diameter. Allow the puddle to set for at least 60 seconds, and then insert the digital alkalinity-pH meter probe into the puddle. Allow the meter to calculate results for 15 seconds and record the meter readings.
- 3) Concrete substrates must test between pH 8.0 and 10.0 before flooring materials are installed; slabs may not exceed pH 10.0.
- 4) Readings exceeding pH 10.0 may affect coating or covering. Verify permissible pH levels with individual flooring manufacturers.
- c. RH Probe Test: Conduct *in situ* RH probe testing in conformance with ASTM F 2170
 - 1) Concrete floor slabs must be at the in-service temperature and the occupied air space above the slab must be at the in-service temperature and RH for at least 48 hours before taking RH measurements in the substrate.
 - 2) Perform at least 3 tests for the first 1,000 square feet and at least one test for every additional 1,000 square feet or fraction thereof.
 - 3) At below-grade substrates, choose testing locations within 3 feet of each exterior wall.
 - 4) Drill probe holes 40 percent down into the slab for slabs drying from the top only; 20 percent into the slab for slabs drying from top and bottom.
 - 5) Use a vacuum cleaner to remove dust from drilled holes, and allow at least 72 hours for holes to achieve moisture equilibrium within each hole before taking RH measurements.
 - 6) After the 72-hour equilibrium period, insert probes and allow a 30-minute period for each probe to reach temperature equilibrium before measuring RH.
 - 7) Use the RH probe to measure the ambient air temperature and RH above the slab in the vicinity of the hole.
 - 8) RH readings exceeding 75 percent may affect coating or covering. Verify permissible RH levels with individual flooring manufacturers.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, and re-inspection and re-testing costs, without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and

3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

END OF SECTION

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SECTION 09 22 26 – METAL SUSPENSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal furring and framing systems for supporting suspended gypsum board ceilings.
2. Delegated design of metal furring and framing assemblies.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. BMT: Base Metal Thickness.msg
2. MSG: Manufacturer's Standard Gage for Sheet Steel.
3. HDG: Hot Dip Galvanized.

B. Definitions:

1. Manufacturer: Means the metal suspension system manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Delegated Design Requirements:

1. Where engineering is required, including when manufacturer's loading tables are exceeded, engineer, fabricate, assemble, and install suspension systems that conform to the profiles indicated and other Contract Document requirements; meet specified performance criteria; and result in structurally sound, and non-corroding assemblies that accommodate, resist, distribute, or transfer in-service loads without incipient or catastrophic failure.
2. Maintain visual design concept indicated, including sizes, profiles, and alignments. Deviation from visual design concept is non-conforming work and prohibited without prior written acceptance by the Architect.

B. Performance Requirements:

1. Superstructure Deflection and Story Drift: Accommodate design displacement of adjacent stories indicated on the structural drawings.
 2. Seismic Loads: Resist, distribute, or transfer seismic loads indicated on the structural drawings without incipient or catastrophic failure.
 3. Perpendicular Deflection (Convexity and Concavity): Drywall support system may not deflect more than $L/240$, measured normal to the assembly plane.
- C. Acoustic Requirements: Where materials are part of an STC-rated assembly, provide items within the assembly that are identical to or better than those products indicated as listed and tested in conformance with ASTM E 90 and ATM E 413.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Delegated Design Submittals: Together with shop drawings, submit engineering calculations demonstrating conformance to the Contract Documents and all impacts of delegated design scope of work on other work.
 - a. Calculations must be explicit and legible and must incorporate distinct cross-references to submitted shop drawings in sufficient quantity to render the calculations readily intelligible and reviewable.
 - b. At a minimum, calculations must include design loads; analysis of supporting construction, including section-property computations; analysis of fasteners, anchors, attachments, and connectors; and signature and seal of the licensed professional engineer responsible for preparing them.
 - c. Test reports are not an acceptable substitute for calculations and are returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.

2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Suspension system components must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Quality Standards:

1. Comply with all requirements of the California Building Code (CBC).

C. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing suspension systems for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing suspension systems for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading suspension system installers.
3. Engineer: Must be a licensed professional structural engineer registered to practice in California having at least 10 years' experience performing the kind of engineering services indicated for at least 20 previous projects similar to this project in size, material, design, and complexity.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage and bracing during storage.
1. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to other sources of deterioration and damage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective suspension system components with undamaged new suspension system components that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.

2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
- ## 2.2 MANUFACTURERS
- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. California Expanded Metal Products Co. (CEMCO)

2. ClarkDietrich Building Systems.
3. Olmar Supply Inc.
4. SCAFCO Corp.

2.3 MATERIALS

- A. Cold-Formed Metal Framing: ASTM A 1003, ST50 (Structural Grade 50), with at least a G60 coating weight designation (mass designation) on both surfaces with equal coating weight on each surface.
- B. Lightgauge Metal Framing: ASTM C 645 manufactured from HDG metallic-coated steel sheet conforming to ASTM A 1003, NS33 (Non-Structural Grade 33), with at least a G40 coating weight designation (mass designation) on both surfaces with equal coating weight on each surface.

2.4 COMPONENTS

- A. Galvanized Carbon Steel Wire:
 1. Hanger Wire: At least 0.162-inch diameter (SWG 8).
 2. Diagonal Bracing Wire: At least 0.106-inch diameter (SWG 12).
 3. Tie Wire: At least 0.050-inch diameter (SWG 18).
- B. Standard Furring Clips:
 1. Application: Used in lieu of tie wire to attach metal furring channels to 1-1/2-inch U-channels in drop ceiling assemblies.
 2. Restrictions:
 - a. Clips must be installed on alternating sides of carrying channels. Use tie wire when clips cannot be alternated.
 - b. Clips must only be used when single-layer gypsum or single-layer veneer plaster base is used. Otherwise use tie wire.
 3. Product: "Metal Furring Channel Clips (MFCC)" manufactured by Clarkwestern Dietrich Building Systems LLC, or equal.
- C. Resilient Sound Isolation Furring Clips:
 1. Application: Used in lieu of tie wire to attach metal furring channels to 1-1/2-inch U-channels in drop ceiling assemblies.
 2. Restrictions:
 - a. Clips must be installed on alternating sides of the 1-1/2-inch channels. Use tie wire when clips cannot be alternated.
 - b. Clips must only be used when single-layer gypsum or single-layer veneer plaster base is used. Otherwise use tie wire.
 - c. Carrying channels (U-channels) may not exceed 48-inch on center spacing.
 - d. Furring channels (hat channel) may not exceed 24-inch on center spacing.
 3. Product: "GenieClip C3" manufactured by Pliteq Inc., or equal.

- D. Flat Hangers (Straps):
 - 1. Width: At least 2 inches.
 - 2. Minimum Thickness: At least 97 mils BMT (MSG 12).
- E. U-Channel or Cold Rolled Channel (CRC) Carrying Channels:
 - 1. Deep: 3/4- or 1-1/2-inches.
 - 2. Minimum Thickness: At least 97 mils BMT (MSG 12).
 - 3. Flanges: 1/2 inch wide.
- F. Hat Furring Channels:
 - 1. Products: "Hat" or "F" furring channel manufactured by CEMCO, or equal.
 - 2. Depth: 7/8- or 1-1/2-inch deep, as indicated.
 - 3. Minimum Thickness: At least 30 mils BMT (MSG 20).
 - 4. Web: 1-1/4 inches wide or 2-1/2 inches.
 - 5. Screw Flanges: 1/2-inch wide.

2.5 ACCESSORIES

- A. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- B. Seismic Separation Joints: Provide seismic separation joints at ceiling locations where the contiguous area of non-broken ceiling is 2,500 square feet or greater.
- C. Compression Struts:
 - 1. Cold or hot rolled angles, loadbearing or non-loadbearing studs, EMT or rigid conduit, or black iron.
 - 2. Cold-rolled steel section with maximum L/R ratio of 200.
- D. Screw Fasteners: Provide #8-32 UNC 2B (0.164-inch shank diameter, 32 threads per inch) by at least one-inch long, pan head, coarse thread, self-piercing or self-drilling as applicable, chromate finish zinc-plated steel screw fasteners, unless another fastener type is explicitly indicated; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- E. Power-Actuated Fasteners:
 - 1. Description: ICC-ES-approved anchors conforming to California Building Code Occupancy Category III, Seismic Design Category E, unless a more stringent Occupancy Category or Seismic Design Category is indicated on the Structural Drawings.
- A. Manufacturer: Provide products manufactured by Hilti, Inc., or equal.
- F. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

- G. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install suspension systems using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Installed suspension systems must be warrantable. Do not install, correct, or replace suspension systems in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach suspension systems to supporting construction.
- C. Installation Tolerances: Install suspension systems within the following tolerance variations.
 - 1. Maximum Out of Plane: Surfaces may not vary by more than 1/8-inch in 10 feet.
 - 2. Carrying Channel Maximum Out of Level: Not more than 1/8-inch in 12 feet,
 - 3. Main Runner Maximum Out of Level: Not more than 1/4-inch in 10 feet,
 - 4. Main Runner Maximum Deflection: Not more than L/360 of span,
 - 5. Maximum Misalignment of Main Runners: 0.015-inch.

6. Maximum Misalignment of Intersection Members: 0.020-inch.
7. Main Runner Bow, Camber, and Twist: Not more than 1/32-inch in 2 feet bow or camber; not more than one degree twist.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 09 22 39 – VENEER PLASTER BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Veneer plaster base gypsum wall panels.
2. Installation materials.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 26 13 for joint treatment.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the plaster base manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished plaster bases.

- a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 1. Plaster bases must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Quality Standard:
 1. Product and Performance Standard: Comply with the AWCI publication "*Technical Manual 7: Veneer Plaster Manual – 111*" requirements for all aspects of veneer plastering.

1.5 HANDLING

- A. General: Comply with the GA publication GA 801 "*Handling Gypsum Board*" and applicable requirements of ASTM C 1264 for the inspection, rejection, certification, packaging, marking, shipping, handling, and storage of gypsum panel products.

- B. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- C. Storage: Store unloaded items as shipped, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
 - 1. Store items indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas; where “wet work” within storage areas (e.g., concrete, cast underlayment, mortaring, grouting, plastering, gypsum board finishing, etc.) is complete and cured or dried to a condition of equilibrium.
 - 2. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
- D. Handling: Handle items in conformance with manufacturer’s instructions and other requirements and recommendations, and in a manner that that prevents damage.
- E. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- F. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project’s performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.

- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
1. CertainTeed Corp.
 2. GP Building Products.
 3. National Gypsum Co.
 4. USG Corp.

2.3 VENEER PLASTER BASE GYPSUM PANELS

- A. Description: Rigid interior gypsum veneer plaster base conforming to ASTM C 1396.
- B. Product: "IMPERIAL Gypsum Base" manufactured by USG Corp., or equal.
- C. Requisite Properties:
 - 1. Minimum Size: Provide at least 4-foot by 8-foot sheets.
 - 2. Minimum Thickness: 5/8-inch.
 - 3. Core: Provide Type X panels in walls and Type C panels in ceilings, unless otherwise indicated on the Drawings.
 - 4. Edges: Tapered long edges and square ends.
 - 5. Facers: Multi-layered laminated face paper face, back, and long edges designed to control water absorption, provide a strong plaster bond, and resist plaster slide.

2.4 INSTALLATION MATERIALS

- A. Fasteners: Provide 0.164-inch shank diameter (#8-32 UNC) by at least 1-1/4-inch-long Philips drive socket, bugle or wafer head, self-drilling stainless steel, bi-metal, duplex anti-corrosive steel, 3-coat anti-corrosive steel, or ceramic-coated anti-corrosive steel screw fasteners specified in Section 05 05 23, unless another fastener type is explicitly indicated; or is otherwise supplied, required, recommended, or accepted by the manufacturer.

2.5 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install plaster bases using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed plaster bases must be warrantable. Do not install, correct, or replace plaster bases in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items:

1. Provide materials, components, and accessories normally furnished or necessary to securely attach plaster bases to supporting construction.
2. Do not install vapor retarders directly behind plaster base.

C. Installation Tolerances: Install plaster bases to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 09 25 14 – ACRYLIC PLASTER FINISH

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acrylic plaster finish.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the acrylic plaster finish manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified finishes are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
2. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.

B. Sequencing: Install acrylic plaster finishes only after penetrating items are installed and after overhead finishing operations are complete,

C. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.

2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed plaster finishes. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 3. Samples: Submit at least 8-inch square representative color samples of each acrylic plaster finish type, color, finish with typical trim and joints intersecting at the center of each sample. Stepped samples must include each coat or layer, including leveling coat, reinforcing mesh, primer, and finish coat separately identified by manufacturer's name and product name or stock number.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished plaster finishes.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 1. Acrylic plaster finishes must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Qualifications:
 1. Installer: Company or individuals must have at least 5 years' experience installing acrylic plaster finishes for at least 30 previous projects similar to this project in size, material, design, and complexity.
 2. Supervisors: Individuals must have at least 7 years' experience installing acrylic plaster finishes for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading acrylic plaster finish installers.

- C. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate acrylic plaster finishes into the mockup as part of the work of this specification section.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped and in conformance with manufacturer's instructions and other requirements and recommendations for storage. Furnish adequate dunnage during storage.
 - 1. Prevent stored items from contacting the floor or ground and from deterioration and damage.
 - 2. If items are not stored in an enclosed location, then cover the tops and sides with securely-tied, waterproof, and breathable covers. Unvented polyethylene tarpaulins do not qualify as breathable covers and are prohibited. (due to potential accumulation of moisture beneath tarpaulin during certain environmental conditions)
 - 3. Incline covered items to ensure maximum drainage of accumulated moisture.
 - 4. Do not leave items uncovered where they might be exposed to weather or become wet from rain, mist, relative humidity, condensation, frost, and other sources of moisture; or exposed to other sources of deterioration and damage, including heat and sudden changes in temperature, and UV exposure beyond manufacturer-recommended limits.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 - 1. Avoid damage to packaging and containers, and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective acrylic plaster finishing materials with undamaged new acrylic plaster finishing materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install acrylic plaster finishes only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.

B. Other Conditions:

1. Substrate Tolerance: Surfaces receiving acrylic plaster finishes must be flat with 1/4-inch within any 10-foot radius.
2. Deflection: Maximum of substrate deflection under positive or negative design loads must not exceed L/360 of span.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for the work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.

2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
3. Preference is given to product inventoried to at least 0.01% (100 ppm).
4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
5. Preference is given to Declare labels designated as Red List Free.

D. Low-Emitting Materials criteria:

1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 ACRYLIC PLASTER FINISH

A. Manufacturers: Provide products manufactured by one of the following, or equal.

1. Dryvit Systems, Inc.
2. Parex USA, Inc.
3. Sto Corp.

B. Reinforced Acrylic Leveling Coat:

1. Description: 100-percent, acrylic polymer based, reinforced leveling coat used for enhanced crack resistance and embedding reinforcing mesh.
2. Product: "Parex 121 Base Coat & Adhesive" manufactured by Parex USA, Inc., or equal.

C. Reinforcing Mesh:

1. Description: Symmetrical, interlaced open-weave alkali-resistant glass fiber fabric made with minimum 20 percent by weight alkaline resistant coating for compatibility with finish materials.
2. Products: Provide the following manufactured by Parex USA, Inc., or equal.
 - a. Standard Mesh: "355 Standard Mesh", or equal, 4.5 ounce per square yard fiberglass mesh.
 - b. Detail Mesh: "356 Short Detail Mesh", or equal, 4.5 ounce per square yard fiberglass mesh.
 - c. Corner Mesh: "357 Corner Mesh", or equal, 7.2 ounce per square yard fiberglass mesh.

- d. Intermediate Impact Mesh: "358.10 Intermediate Impact Mesh", or equal, 12 ounce per square yard fiberglass mesh.
 - e. High Impact Mesh: "358.14 High Impact Mesh", or equal, 15 ounce per square yard fiberglass mesh.
 - f. Ultra-High Impact Mesh: "358.20 Ultra High Impact Mesh", or equal, 20 ounce per square yard fiberglass mesh.
 - g. Reinforced Preformed Mesh: "360 Fast Window Mesh" fiberglass mesh, or equal.
- D. Acrylic Primer:
- 1. Description: Acrylic-based primer designed to reduce the chance of efflorescence and enhance finish appearance and uniformity.
 - 2. Product: "Parex 310 Primer" manufactured by Parex USA, Inc., or equal; tint to match finish coat colors.
- E. Acrylic Finish Coat:
- 1. Description: Factory blended, 100-percent acrylic polymer-based, integral-color plaster finish coat.
 - 2. Product: "DPR Optimum Finish" manufactured by Parex USA, Inc., or equal.
 - 3. Requisite Properties:
 - a. Color: Indicated on the Drawings or selected by the Architect.
 - b. Finish: 583 Sand Smooth.

2.3 ACCESSORIES

- A. Bonding Agent:
- 1. Description: 100-percent acrylic emulsion additive for Portland cement-based products.
 - 2. Product: "Adacryl" manufactured by Parex USA, Inc., or equal.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.4 MIXING

- A. Factory-Mixed Products:
- 1. Open acrylic plaster finish packaging and containers only as required for use and mix only in designated areas.
 - 2. Thoroughly agitate and stir acrylic plaster finish materials to a uniform and smooth consistency suitable for proper installation.
 - 3. Do not reduce, alter, or introduce foreign materials into acrylic plaster finish materials, except in conformance with manufacturer's instructions and other requirements and recommendations.

- B. Site Mixing: Batch mix acrylic plaster finish materials in conformance with manufacturer's instructions and other requirements and recommendations, using manufacturer-recommended techniques and manufacturer-recommended mechanical mixing equipment, which must be clean and free of material from previously mixed batches before charging each subsequent batch.
 - 1. Measure mix materials using only graduated mixing containers and calibrated mixing equipment. Shovels do not qualify as graduated mixing containers or calibrated equipment, and are prohibited from measuring or dispensing mix materials.
 - 2. Thoroughly agitate and stir mix materials to a uniform and smooth consistency suitable for proper installation.
 - 3. Do not reduce, alter, or introduce foreign materials into mix materials, except in conformance with manufacturer's instructions and other requirements and recommendations.
 - 4. Do not use caked or lumpy materials; or materials that are irregular, too thick or too thin, or that are partially set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify substrates are free of deleterious and other substances that might interfere with acrylic plaster finish adhesion, appearance, or performance.
 - 3. Verify items penetrating acrylic plaster finishes are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and acrylic plaster finish installation.
 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
 3. Opening Protection: Close and protect drains and other openings and penetrations to prevent intrusion or migration of liquids.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any specified or other warranty or guarantee becoming void.

3.3 INSTALLATION

A. General Requirements:

1. Install acrylic plaster finishes using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install acrylic plaster finish under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. Acrylic plaster finish surfaces with soft spots, holidays, streaks, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed acrylic plaster finishes must be warrantable. Do not install, correct, or replace acrylic plaster finishes in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Apply finish coat not less than 7 days after brown coat is applied. Dampen brown coat thoroughly and apply finish coat to a uniform minimum thickness of 1/8-inch to match approved mockup. Correct irregularities prior to application.
2. Provide sufficient manpower and equipment to ensure a continuous operation free of cold joints, scaffold lines, texture variations, and other objectionable conditions.
 - a. Plaster surfaces full height and width between control joints in one operation once the application of any coat has begun.
 - b. Stop acrylic plaster finishes at control joints, edges, or corners only.
 - c. Apply acrylic plaster finishes flush with metal trim members and make corners square and true.
3. Finish plaster in a true, plumb or level plane flush with grounds.
4. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate acrylic plaster finish at metal frame, cut base coat free from metal frame

before acrylic plaster finish sets and groove finish coat at junctures with metal. Apply sealant in groove to metal frame.

5. Protection Measures during Application and Cure:
 - a. Protect acrylic plaster finishes in conformance with manufacturer's instructions.
 - b. Protection measures must shield the completed finish coat from direct sunlight and wind exposure (i.e., provide dark colored coverings or barriers).
 - c. The combination of curing and protection measures that are employed must prevent drying, uneven or excessive evaporation, and strong natural or artificial blasts of dry air during the curing period.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed acrylic plaster finishes in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed acrylic plaster finishes unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed acrylic plaster finishes as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 28 15 – GMF GYPSUM TILE BACKING BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. GMF gypsum backing board.
2. Installation materials.
3. Joint treatment materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 06 16 43 for GMF gypsum sheathing.
3. Section 07 54 19 for GMF roof cover boards.
4. Section 09 29 00 for requirements for marking and identification of wall and partition construction required to have protected openings or penetrations.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. GMF: Glass Mat Faced.

B. Definitions:

1. Manufacturer: Means the backing board manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished backing boards.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Backing boards must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Backing board must be manufactured in North America by a domestic company from gypsum mined in North America; synthetic gypsum recovered from coal-fired plants operating in North America (FGD gypsum); or a combination of both.
 - a. Backing board manufactured outside of North America by a domestic company are prohibited.
 - b. Backing board manufactured outside of North America by a foreign company and relabeled or rebranded by a domestic company are prohibited.

3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.5 HANDLING

- A. General: Comply with GA publication GA 801 "*Handling Gypsum Board*" and applicable requirements of ASTM C 1264 for the inspection, rejection, certification, packaging, marking, shipping, handling, and storage of gypsum panel products.
- B. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Unload and store only inspected and accepted items.
- C. Storage: Store unloaded items as shipped, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
 1. Store items indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas; where "wet work" within storage areas (e.g., concrete, cast underlayment, mortaring, grouting, plastering, gypsum board finishing, etc.) is complete and cured or dried to a condition of equilibrium.
 2. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
- D. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- E. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- F. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
 - 1. CertainTeed Corp.
 - 2. GP Building Products.
 - 3. National Gypsum Co.
 - 4. USG Corp.

2.3 GMF GYPSUM BACKING BOARD

- A. Description: Gypsum-based GMF water-resistant gypsum backing panel conforming to ASTM C 1178 installed as a base for the application of ceramic tile.
- B. Applications: Installed as a base for the application of ceramic tile and behind fiberglass bathtub surround walls.
- C. Restrictions: May not be used
 - 1. as a base for nailing or mechanical fastening;
 - 2. as a radiant barrier behind fireplaces;
 - 3. in exterior applications; and
 - 4. In direct contact with concrete or concrete masonry units.
- D. Products: Provide one of the following, or equal.
 - 1. "DensShield Tile Backer" manufactured by GP Building Products.
 - 2. "GlasRoc Tile Backer" manufactured by CertainTeed Corp.
 - 3. "Gold Bond eXP Tile Backer" manufactured by National Gypsum Co.
- E. Requisite Properties:
 - 1. Minimum Size: At least 4-foot by 8-foot sheets.
 - 2. Minimum Thickness: 1/2-inch regular core panels and 5/8-inch Type X panels.
 - 3. Minimum Mass: At least 2.2 pounds per square foot.
 - 4. Edges: Tapered long edges and square ends.
 - 5. Facers: Heat-cured, acrylic-coated, fiberglass mat wrapped around panel face, back side, and long edges. Water repellent paper facers and backings are prohibited.
- F. Performance Requirements:
 - 1. Resistance to the Propagation of Mold and Mildew: Minimum score of 10 (no visual defacement), when tested in conformance with ASTM D 3273.

2.4 INSTALLATION MATERIALS

- A. Fasteners: Provide 0.164-inch shank diameter (#8-32 UNC) by at least 1-1/4-inch-long Philips drive socket, bugle or wafer head, self-drilling stainless steel, bi-metal, duplex anti-corrosive steel, 3-coat anti-corrosive steel, or ceramic-coated anti-corrosive steel

screw fasteners, unless another fastener type is explicitly indicated; or is otherwise supplied, required, recommended, or accepted by the manufacturer.

2.5 JOINT TREATMENT MATERIALS

A. Glass Mesh Tape:

1. Description: 2-inch wide, alkali-resistant, polymer-coated, 10x10 glass-fiber mesh tape.
2. Application: Used in combination with joint sealant as a panel joint and penetration treatment for long-term joint protection.
3. Product: Supplied, required, recommended, or accepted by the manufacturer.

B. Polymer-Modified Cementitious Mortar:

1. Description: Premium-grade (best quality grade), single-component, ultra-high-performance, polymer-modified Portland cement mortar conforming to A118.15 shear bond strength requirements.
2. Application: Used for embedding joint tape and finishing backing board in wet locations (e.g., toilet rooms, shower rooms, saunas, steam rooms, kitchens, swimming pool enclosures, etc.). Do not use drying-type joint compound, setting-type joint compound, or paper tape in wet locations.
3. Products: Provide one of the following, or equal.
 - a. "MegaFlex Crack Prevention Mortar" manufactured by Custom Building Products.
 - b. "254 Platinum" manufactured by LATICRETE International, Inc.
 - c. "Ultraflex 3" manufactured by Mapei Corp.

C. Setting-Type Joint Compound:

1. Description: Lightweight, sandable, chemically setting powder compound conforming to ASTM C 475 and
2. Application: Used for embedding joint tape and finishing backing board in locations other than wet locations. All-purpose and drying type joint compounds are prohibited.
3. Product: "ToughRock Sandable Setting Compound" manufactured by GP Building Products, or equal.

2.6 ACCESSORIES

- A. Sealant: Provide fluid-applied low modulus joint sealant specified in Section 07 92 00, unless another type of sealant; or supplied, required, recommended, or accepted by the manufacturer to seal sheathing joints and fastener penetrations.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install backing boards using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed backing boards must be warrantable. Do not install, correct, or replace backing boards in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items:
 - 1. Provide materials, components, and accessories normally furnished or necessary to securely attach backing boards to supporting construction.
 - 2. Do not install vapor retarders directly behind backing board.
- C. Installation Tolerances: Install backing boards to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

END OF SECTION

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SECTION 09 29 00 – GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board panels.
2. Metal trim.
3. Installation materials.
4. Joint treatment materials.
5. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 06 16 43 for GMF gypsum sheathing.
3. Section 07 54 19 for GMF roof cover boards.
4. Section 09 28 15 for GMF gypsum tile backing board.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. GMF: Glass Mat Faced.

B. Definitions:

1. Manufacturer: Means the gypsum board manufacturer, unless otherwise indicated.
2. Enclosure: Means a level of protective resistance to weather provided for interior spaces during the construction phase by either permanent construction or substantial temporary construction. Other terms, including "enclosed" and similar terms, have the same meaning as "enclosure".
 - a. Uncontrolled Enclosure: Means short-term, limited, temporary protection against wind for up to 6 months before completion of the permanent enclosure, as determined by the Architect, whose decision is final.
 - b. Partially-Controlled Enclosure: Means medium-term, limited, temporary protection against both wind and rain for up to 12 months before completion of the permanent enclosure, as determined by the Architect, whose decision is final.
 - c. Permanent Enclosure: Means complete permanent protection against wind, temperature, humidity, atmospheric pressure, and precipitation; provided by a permanent insulated and weathertight roofing system, permanent insulated and

- weathertight exterior wall construction, and openings closed with permanent protectives or substantial temporary closures equivalent in protection to permanent protectives, as determined by the Architect, whose decision is final.
3. Dry-In: Means that the building shell is sufficiently complete to keep out wind, rain, and other weather. Other terms, including "box-in" and similar terms, have the same meaning as "dry-in". At a minimum, dry-in includes
 - a. all exterior walls are constructed with weather-resistive barrier or air barrier applied;
 - b. roof deck is installed with an appropriate waterproof covering; and
 - c. windows and doors are installed.
 4. Locations:
 - a. Wet Locations: Means interior locations subject to moisture during normal activities for which the space was designed (e.g., toilet rooms, shower rooms, saunas, steam rooms, kitchens, swimming pool enclosures, etc.)
 - b. Dry Locations: Means normally dry interiors.
 5. Pre-Rock Construction: Means the limited installation of gypsum board panels in locations exposed to ambient moisture during the normal construction cycle before the structure is either partially controlled or permanently enclosed. Pre-rock construction is not limited to top-down construction. Other terms, including "pre-dry-in" and similar terms, have the same meaning as "pre-rock".
 6. Top-Down Construction: Means the limited installation of gypsum board panels only in plenums above the finished ceiling plane after the installation of metal framing is complete and before the installation of ducts, conduits, pipes, or other items that penetrate the gypsum board assemblies begins.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate locations of control joints to ensure the recommended spacings of control joints for gypsum wall and ceiling panels are accommodated.
 - a. If control joints are not indicated on the construction drawings, do not anticipate the quantity is zero.
 - b. Propose locations on shop drawings or submit an RFI to the Architect before submitting bid proposal.
2. Final locations of control joints are subject to Architect's approval.

B. Preinstallation Meeting:

1. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation.
3. Discuss and finalize locations and extents of all control joints.

4. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed underlayment. Resolve each condition.
 5. Finalize construction schedule.
 6. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.
- C. Sequencing: Deliver paper-faced gypsum board to the project site only after building dry-in.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing locations, sizes, and extents of all control joints. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished gypsum board.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.

2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Gypsum board must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Gypsum board must be manufactured in North America by a domestic company from gypsum mined in North America; synthetic gypsum recovered from coal-fired plants operating in North America (FGD gypsum); or a combination of both.
 - a. Gypsum board manufactured outside of North America by a domestic company are prohibited.
 - b. Gypsum board manufactured outside of North America by a foreign company and relabeled or rebranded by a domestic company are prohibited.
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing gypsum board for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing gypsum board for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading gypsum board installers.

1.6 HANDLING

- A. General: Comply with GA publication GA 801, "*Handling Gypsum Board*" and applicable requirements of ASTM C 1264 for the inspection, rejection, certification, packaging, marking, shipping, handling, and storage of gypsum panel products.

- B. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.
- C. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 - 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- D. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- E. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective gypsum board with undamaged new gypsum board that does not exhibit deterioration, damage, or defects.
- F. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.

2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.

- 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturer: Provide products manufactured by one of the following, or equal.
 1. CertainTeed Corp.
 2. GP Building Products.
 3. National Gypsum Co.
 4. USG Corp.

2.3 PRE-ROCK GYPSUM BOARD

- A. Description: GMF interior gypsum panels conforming to ASTM C 1658.
- B. Application: Pre-rock panels must be used when gypsum board is installed prior to dry-in.
- C. Products: Provide one of the following, or equal.
 1. "DensArmor Plus Interior Panels" manufactured by GP Building Products.
 2. "e2XP Interior Extreme" manufactured by National Gypsum Co.
 3. "SHEETROCK Glass-Mat Panels Mold Tough" manufactured by USG Corp.
- D. Requisite Properties:
 1. Minimum Size: Provide at least 4-foot by 8-foot sheets.
 2. Minimum Thickness: 5/8-inch regular core panels and 5/8-inch Type X panels.
 3. Edges: Tapered long edges and square ends.
 4. Facers: Heat-cured, acrylic-coated, fiberglass mat on the face side, back side, and around long edges. Water repellent paper facers and backings are prohibited.

2.4 FIRE-RESISTANCE RATED GYPSUM BOARD

- A. Fire-Resistance-Rated Gypsum Wall and Ceiling Board:
 1. Description: Gypsum board conforming to ASTM C 1396.
 2. Applications: Installed in fire-resistance-rated and non-rated interior partition assemblies constructed in dry locations.
 3. Products: Provide one of the following, or equal.
 - a. "ProRoc Type X" and "ProRoc Type C" manufactured by CertainTeed Corp.
 - b. "ToughRock Fireguard" and "ToughRock Fireguard C" manufactured by GP Building Products.

- c. "Gold Bond Fire-Shield" and "Gold Bond Fire-Shield C" manufactured by National Gypsum Co.
 - d. "SHEETROCK "Firecode Core"" and "SHEETROCK "Firecode C Core""
- 4. Requisite Properties:
 - a. Minimum Size: At least 4-foot by 8-foot sheets.
 - b. Minimum Thickness: At least 5/8-inch.
 - c. Core: Provide Type X panels in walls and Type C panels in ceilings, unless otherwise indicated on the Drawings.
 - d. Minimum Mass: At least 2.2 pounds per square foot.
 - e. Edges: Tapered long edges and square ends.
 - f. Facers: Paper face, back, and long edges.
- B. Mold- and Moisture-Resistant Fire-Resistance-Rated Gypsum Wall and Ceiling Board:
 - 1. Description: Mold- and moisture-resistant and fire-resistance-rated gypsum board conforming to ASTM C 1396.
 - 2. Applications: Installed as the inside face of exterior wall assemblies; and in fire-resistance-rated and non-rated interior partition assemblies constructed in wet locations.
 - 3. Products: Provide one of the following, or equal.
 - a. "ProRoc Moisture and Mold Resistant Gypsum board with M2Tech" manufactured by CertainTeed Corp.
 - b. "ToughRock Mold-Guard" manufactured by GP Building Products.
 - c. "Gold Bond XP Gypsum Board" manufactured by National Gypsum Co.
 - d. "SHEETROCK Mold Tough" manufactured by USG Corp.
 - 4. Requisite Properties:
 - a. Minimum Size: At least 4-foot by 8-foot sheets.
 - b. Minimum Thickness: At least 5/8-inch.
 - c. Core: Provide Type X panels in walls and Type C panels in ceilings, unless otherwise indicated on the Drawings.
 - d. Minimum Mass: At least 2.2 pounds per square foot.
 - e. Edges: Tapered long edges and square ends.
 - f. Facers: Heavy-duty mold- and moisture-resistant paper face, back, and long edges.
 - 5. Performance Requirements:
 - a. Mold Resistance: Must earn a score of at least 10, when tested in conformance with ASTM D 3273.

2.5 METAL TRIM

- A. Steel Trim:
 - 1. Description: Paper-faced galvanized steel sheet trim pieces conforming to ASTM C 1047.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.

- a. CEMCO.
 - b. Clinch-On Cornerbead Co.
 - c. Stockton Products.
 - d. Western Metal Lath.
 - e. USG Corp.
3. Products: "BEADDEX" paper-faced metal bead and trim manufactured by USG Corp., or equal.
 - a. Corner Beads: Provide to protect exterior corners. Provide corner beads with notched or flexible flanges at curved edges.
 - 1) 90-degree Outside Corner Bead: "Micro Bead Style", or equal.
 - 2) 90-degree Inside Corner Bead: "B2 Style", or equal.
 - b. Casing Beads: Provide long-flanged L- or LC-beads at exposed panel edges indicated as receiving joint compound; provide short-flanged U-beads at exposed panel edges that do not receive joint compound.
 - 1) J Trims (J-shaped with exposed long flange): "B9J Style", or equal.
 - 2) L Trims (L-shaped with exposed long flange): "B4 Style", or equal.
- B. Decorative Aluminum Trim:
 1. Products: Provide the following manufactured by Fry Reglet Corp., or equal.
 - a. "Z Series Reveal".
 - b. "F Series Reveal".
 2. Requisite Properties:
 - a. Color: Indicated on the Drawings or selected by the Architect.
- C. Metal Control Joints:
 1. Description: One-piece solid zinc control joint supplied with factory-applied removable tape to ensure a clean joint.
 2. Products: Provide one of the following, or equal.
 - a. "N093 Control Joint" manufactured by Alabama Metal Industries Corp. Building Products (AMICO).
 - b. "Niles-093 Zinc Control Joint" manufactured by Niles Building Products Co.
 - c. "SHEETROCK Zinc Control Joint No. 093" manufactured by USG Corp.
 3. Requisite Properties:
 - a. Minimum Length: At least 10 feet long; provide longest possible lengths to minimize or avoid joints.

2.6 INSTALLATION MATERIALS

- A. Fasteners: Provide #6-32 UNC 2B (0.138-inch shank diameter, 32 threads per inch) by at least 1-1/4-inch long, Philips bugle head, coarse thread, self-piercing or self-drilling (as applicable) phosphate coated steel screw fasteners, unless another fastener type is explicitly indicated; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

B. Laminating Adhesive:

1. Description: Lightweight, sandable, chemically-setting powder compound conforming to ASTM C 475.
2. Application: Used for bonding gypsum board to studs, laminating gypsum board to gypsum board, and bonding gypsum board to concrete or CMU walls.
3. Product: "SHEETROCK Easy Sand Joint Compound" manufactured by USG Corp., or equal.

2.7 JOINT TREATMENT MATERIALS

A. Joint Tape:

1. Description: Nominal 2-inch wide gypsum panel joint and corner reinforcement conforming to ASTM C 475.
2. Products:
 - a. Fiberglass Joint Tape: "SHEETROCK Fiberglass Drywall Tape" manufactured by USG Corp., or equal.
 - b. Paper Joint Tape: "BEADDEX Drywall Joint Tape" manufactured by USG Corp., or equal.
 - c. Fiberglass Mesh Tape: Prohibited.

B. Setting-Type Joint Compound:

1. Description: Lightweight, sandable, chemically setting powder compound conforming to ASTM C 475, and used for embedding joint tape and finishing interior gypsum panels.
2. Applications:
 - a. Pre-Filling Gypsum Panel Joints throughout the Project: Use setting-type compound for open joints, beveled panel edges, and at damaged surface areas at all locations.
 - b. All Other Coats: Use setting-type compound for embedding and first coat, fill coat, finish coat, and skim coat at wet locations; and at locations where panels are subject to moisture and high humidity.
3. Product: "SHEETROCK DURABOND" manufactured by USG Corp., or equal.

C. Drying-Type Joint Compound:

1. Description: Vinyl-type compound conforming to ASTM C 475, and used for embedding joint tape, finishing interior gypsum panels, and hand-applying simple texturing.
2. Application: Use for embedding and first coat, fill coat, finish coat, and skim coat at dry locations, and at locations where joint is subject to moisture and high humidity.
3. Product: "SHEETROCK All Purpose Joint Compound – SELECT" and "SHEETROCK Brand Plus 3 Lightweight All-Purpose Joint Compound" manufactured by USG Corp., or equal.

2.8 ACCESSORIES

- A. Texture Finish:
 - 1. Description: Unaggregated texture coating wall and ceiling texture.
 - 2. Restrictions: New concrete and new plaster must age at least 60 days before texturing.
 - 3. Concrete Crack Repair and Surface Preparation: Setting-type compound specified above.
 - 4. Primer: "SHEETROCK FIRST COAT Primer" manufactured by USG Corp., or equal.
 - 5. Texture Product: "SHEETROCK TUF-TEX" manufactured by USG Corp., or equal.
 - 6. Finish: Fine orange peel.
- B. Applied Level 5 Wallboard Finish Products: Prohibited.
- C. Repair Clips: "SHEETROCK Drywall Repair Clips" manufactured by USG Corp., or equal.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.9 MARKING AND IDENTIFICATION

- A. Description: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions, and other walls required by the California Building Code to have protected openings or penetrations must be effectively and permanently identified with stenciling located in accessible concealed floors, floor-ceiling assemblies, plenums, and attic spaces
- B. Paint Products: Specified in Section 09 91 00.
- C. Fire Walls, Fire Barriers, and Fire Partitions: Paint 6-inch high stripes not more than 15 feet from the end of each fire wall, fire barrier, or fire partition; and at intervals of not more than 30 feet, when measured horizontally along the wall, barrier, or partition. Paint stenciled letters over the 6-inch high stripes, leaving at least a one-inch border around the stenciled letter copy.
 - 1. Stripe Color: Match Federal Standard 595B color FS 31350 (red).
 - 2. Stenciled Letter Color: Match Federal Standard 595B color FS 37925 (insignia white).
 - 3. Stenciled Letter Font: 288-Point Linotype Neue Helvetica Regular Bold.
 - 4. Stenciled Letter Copy:
 - a. Fire Walls: "FIRE WALL – PROTECT ALL OPENINGS".
 - b. Fire Barriers: "FIRE BARRIER – PROTECT ALL OPENINGS".
 - c. Fire Partitions: "FIRE PARTITIONS – PROTECT ALL OPENINGS".
- D. Smoke Barriers and Smoke Partitions: Paint 6-inch high stripes not more than 15 feet from the end of each smoke barrier or smoke partition; and at intervals of not more than 30 feet, when measured horizontally along the wall, barrier, or partition. Paint stenciled

letters over the 6-inch high stripes, leaving at least a one-inch border around the stenciled letter copy.

1. Stripe Color: Match Federal Standard 595B color FS 36492 (gray).
2. Stenciled Letter Color: Match Federal Standard 595B color FS 37038 (black).
3. Stenciled Letter Font: 288-Point Linotype Neue Helvetica Regular Bold.
4. Stenciled Letter Copy:
 - a. Smoke Barriers: "SMOKE BARRIER – PROTECT ALL OPENINGS".
 - b. Smoke Partitions: "SMOKE PARTITIONS – PROTECT ALL OPENINGS".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 1. Install gypsum board using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed gypsum board must be warrantable. Do not install, correct, or replace gypsum board in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 1. Single-Layer Application:

- a. On ceilings, apply gypsum panels before wall or partition board application to greatest extent possible, and at right angles to framing, unless otherwise indicated.
 - b. On partitions and walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assemblies; minimize end joints.
 - c. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assemblies.
 - d. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - e. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - f. Securely attach gypsum panels to supports with steel drill screws.
2. Multilayer Application:
- a. On partitions and wall assemblies, 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.
 - b. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 - c. Securely attach base layers and face layers separately to supports with screws. Do not glue multiple layers of gypsum board together.
3. Trim:
- a. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim in conformance with manufacturer's instructions.
 - b. Control Joints: Install control joints in conformance with ASTM C 840 and in specific locations indicated or accepted by the Architect.
 - c. Trim: Install cornerbead at outside corners; install LC-Bead or U-Bead at exposed panel edges.
4. Finishing Gypsum Board:
- a. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and other items and conditions as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
 - b. Prefill open joints, beveled edges, and damaged surface areas.
 - c. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

C. Acoustical Installation Requirements:

1. Comply with ASTM C 840.

2. Install panels with face side out. Butt panels together with light contact at edges and ends and not more than 1/16-inch of open space between panels. Do not force into place.
3. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided.
4. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
5. All joints must be staggered at least 24 inches apart and taped and sealed. Where multi-layer construction is indicated, each layer must be complete, including tape, fillers, and seals, before further layers are added
6. Joints between uncut sheet that lie in the same plane must be tight butt joints. The gap between sheets may not exceed 1/8-inch.
7. Tolerances: Install partitions with the following maximum gaps between gypsum board and abutting construction.
 - a. Floor: 1/4-inch.
 - b. Masonry and Concrete Walls: 1/4-inch.
 - c. Underside of Slab or Decking: 1/4-inch.
8. Damaged sheets may not be used. Joints between cut sheets that lie in the same plane or between any sheets that lie in different planes (i.e., at any angle or corner joint) must be cut back to produce a neat gap not more than 1/16-inch wide and the joint filled and sealed with specified non-hardening acoustic sealant. Subsequent layers must cover the joint and the opposite sheet must be cut short and filled and sealed.
9. In the first layer, all joints between boards must be backed by a continuous stud, noggin, bearer, or angle.
10. Specified batt insulation must be placed in the wall cavity and be suitably retained so that it is in contact with only one face of the partition and does not sag.
11. Wall ties between adjacent independent partitions must be of a resilient type and accepted by the Architect. The minimum number compatible with safe construction should be used.
12. The walls must be constructed from slab to slab (full height) unless otherwise indicated.
13. Where door frames are built into the wall, the vertical and horizontal sections of the frame shall be fully filled with plaster. The plaster joint shall be to the full depth of the wall.
14. Top and bottom of stud walls must be Isolated with resilient partition isolation pad (e.g., "Wallmat and Anchor Isolator" manufactured by Kinetics Noise Control, Inc., or equal)
15. Lateral support at the head of vibration isolated gypsum walls must be a continuous steel angle with a resilient pad to avoid rigid contact between the wall and the lateral support construction and accepted by the Architect. (e.g., wall mount type AB by Mason Industries, or equal)
16. All joints between gypsum and other constructions must be dense packed with fiberglass to the full depth of the wall and fully sealed with a sealant bonding to the gypsum and the other construction.

17. Where gypsum walls abut a profiled metal decking, the gypsum wall should seal to a minimum 16 -gage steel plate attached to the deck, with the profile void above the plate filled with fiberglass and acoustically sealed on both sides with a fire barrier putty having a minimum density of 40 pounds per square foot. (e.g., 3M Moldable Putty or equal)
18. For top of walls that are perpendicular with the metal decking maximum of ½ inch gap from the flute and seal the openings with acoustical sealant.
19. Penetrations of building services (e.g., ducts, conduits, pipes) through full height and acoustic rated partitions must be sealed airtight in conformance with the following.
 - a. Seal all annular openings less than 1/2-inch with acoustical sealant and backer rod as required to hold sealant in place.
 - b. When the annular opening is larger than 1/2-inch, provide gypsum board patch to reduce the opening to less than 1/2-inch, and seal as above.
 - c. Prior to sealing penetrations, verify penetrating elements such as piping and ductwork are free and clear of the opening being sealed.
20. Cut-outs must be regular and may not fracture gypsum board core or tear covering and must conform to the following.
 - a. Minimize penetrations of insulated wall and ceiling construction. Penetrate only where necessary and fully seal airtight at the perimeter using acoustical sealant.
 - b. Where ducts and piping greater than 3-inches in diameter penetrate insulated wall or ceiling construction, provide a clearance of one-inch plus 1/4-inch at the perimeter of the penetration
 - c. Where conduit piping 3-inches diameter and less (including mechanical, hydraulic, plumbing, etc.) pass through insulated wall or ceiling construction, provide a clearance of 1/4-inch plus 1/8-inch between the conduit or piping and the structure, unless otherwise shown.
 - d. After the ductwork, conduit, or piping is installed, repair the gypsum board perimeter clearance to the specified tolerance as required. Where the clearance exceeds 3/4-inch, provide a sheet metal sleeve within the partition packed with safing insulation and seal both sides airtight with acoustical sealant.
 - e. Where penetration clearances are 3/8-inch or less, seal airtight with acoustical sealant at gypsum board. Where the perimeter clearance exceeds 3/8-inch, use a flexible backing rod to seal against.
 - f. All gypsum board penetrations (including those resulting from wiring, cables, and electrical junction boxes) must be sealed airtight with acoustical sealant.
 - g. The back and sides of junction boxes in sound-rated construction must be sealed airtight with sheet caulking. Seal perimeter face at gypsum board with acoustical sealant.
 - h. Recessed panel boards, equipment, boxes, and other items having a penetration area greater than 25 square inches at sound-rated partitions are fully enclosed and sealed with 5/8-inch thick gypsum board or 2 pound per square foot sheet metal.
 - i. Seal multiple conduit penetrations airtight with expanding fire foam sealant.

D. Interface with Adjacent Items:

1. Provide materials, components, and accessories normally furnished or necessary to securely attach gypsum board to supporting construction.
 2. Do not install vapor retarders directly behind gypsum board.
- E. Installation Tolerances: Install gypsum board to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed gypsum board in place from deterioration, and damage until Substantial Completion. Remove and replace wet, moisture-, or mold-damaged panels.
1. Indications panels are wet or moisture damaged include discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include fuzzy or splotchy surface contamination and discoloration.
- B. Do not store anything adjacent to or against installed gypsum board unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed gypsum board as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

3.6 GYPSUM BOARD FINISH SCHEDULE

- A. General: Finish gypsum board surfaces with exposed joints, corners and edges reinforced or trimmed in conformance with ASTM C 840, Gypsum Association publication GA-214, *"Recommended Levels of Gypsum Board Finish"*, and the following.
- B. Levels of Gypsum Board Finish:
 - 1. Level 2: Use where moisture-resistant gypsum backing board is used as a substrate for tile; and in storage and similar areas where surface appearance is not of primary concern.
 - 2. Level 4: Use in areas where light texture or backed lightweight wall covering is applied; and all areas indicated as receiving a paint finish, except where Level 5 finish is indicated.
 - 3. Level 5 (spray and roller-applied products are prohibited): Use where indicated on the Drawings.

END OF SECTION

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SECTION 09 30 00 – TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tile surfacing units.
2. Thresholds.
3. Tile waterproofing.
4. Installation materials.
5. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish flooring; and for remedial MVER products.
4. Section 09 62 62 for metal flooring transitions.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. TCNA: Tile Council of North America.

B. Definitions:

1. Manufacturer: Means the tile, installation material, or accessory manufacturer, as the context admits, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected waterproofing and crack isolation membranes and mortar with installed curing compounds and moisture vapor emission control systems, based on current product formulations.
2. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified mortar and grout are prohibited and returned to the

Contractor without review or responsive action, except to record non-conformance with this requirement.

B. Preinstallation Meeting:

1. Hold a meeting after submittal approval and at least 10 business days before beginning installation.
2. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including special details and conditions that might affect installation.
3. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed tile. Resolve each condition.
4. Finalize construction schedule.
5. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Schedule tile deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install tile only after substrate is cured to a condition of equilibrium; is sufficiently dry to bond with tile; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible surface treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
3. Final light fixtures must be completely installed and energized before beginning installation.
4. Install tile only after penetrating items are installed and after overhead finishing operations are complete.

D. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
2. Access Restrictions: Close spaces during installation. Keep closed to foot traffic after installation for at least 48 hours and to rolling load traffic for at least 72 hours.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing floor and wall design patterns and layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
 3. Samples: Submit at least 8-inch square representative samples of each tile variety for each specified color and finish, glued to hardboard backing. Grout all joints with specified grout.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished tile, installation materials, and accessories.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals: Before Final Completion, deliver to the Owner tile cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
1. Furnish at least 2 percent of the total installed for each tile type, color, composition, grade, finish, and variety.
 2. Furnish at least 2 percent of the total amount installed for each grout type, color, and composition. but not less than one unopened container.
- D. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.

- a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Tile must be obtained through one source from the same supplier (to ensure compatibility and appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Installation Materials (Setting Materials): Installation materials, including waterproofing membranes, crack isolation membranes, mortar, adhesive, grout, sealers, and other installation materials and accessories must be obtained through one source from the same manufacturer (to ensure compatibility and a warrantable installation).
3. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Tile Floor Finish Regulatory Requirements:

1. Floor surfaces must be stable, firm, and slip resistant, conforming to the requirements of California Building Code Section 11B-302.1.
2. Allowable Static Coefficient of Friction Value (SCOF): At least 0.6 for level surfaces and at least 0.8 for sloped surfaces, when measured in conformance with ASTM D 2047.
3. Allowable Dynamic Coefficient of Friction Value (DCOF): Between 0.35 and 0.45, when measured in conformance with ANSI B101.3 under wet conditions.
4. Radiant Flux Classification: Provide flooring having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.

C. Tile Wall Finish Regulatory Requirements:

1. Surface-Burning Characteristics: Provide walls and ceilings having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.

D. Quality Standards:

1. Installation Standards: Comply with parts of ANSI A108 Series publication requirements that apply to types of setting and grouting materials and to installation methods indicated.

2. Installation Guidelines: Comply with TCNA publication "*Handbook for Ceramic, Glass, and Stone Installation*" requirements for installation methods indicated.

E. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing tile for at least 30 previous projects similar to this project in size, material, design, and complexity.
 - a. Individuals must be Ceramic Tile Education Foundation (CTEF) Certified Tile Installers and current in their certification.
 - b. Individuals installing large format tile, mudwork for walls or floors, or waterproofing membranes must be certified through Advanced Certifications for Tile Installers (ACT) for installation and current in their certification.
2. Supervisors: Individuals must have at least 7 years' experience installing tile for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading tile installers.
 - a. Supervisors must be Ceramic Tile Education Foundation (CTEF) Certified Tile Installers and current in their certification.
 - b. Supervisors of individuals installing large format tile, mudwork for walls or floors, or waterproofing membranes must be certified through Advanced Certifications for Tile Installers (ACT) for installation and current in their certification.

F. Field Samples: Include *in-situ* mockups as part of the work of this specification section.

1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of tile is made from field samples.
3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective materials with undamaged new materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install tile only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
1. Substrate Dimensional Tolerances: Surfaces receiving tile must be flat with 1/4-inch within any 10-foot radius.
 2. Deflection: Maximum deflection of substrate system under positive or negative design loads must not exceed $L/360$ of span.
 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.

1.8 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for waterproofing products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 10 years.
- B. Installer Guarantee: Furnish to the Owner a written guarantee for waterproofing work of this specification section against all defects in materials and workmanship for 2 years from date of acceptance. Guarantees must be properly prepared and signed on the guarantee form in Division 01.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 1. Florida Tile Inc.
 2. Crossville Inc.
 3. Daltile.
 4. Mosa USA.

2.3 TILE SURFACING UNITS

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 THRESHOLDS

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.5 INSTALLATION MATERIALS

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16, unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Moisture Vapor Transmission Reduction Coating: Specified in Section 03 35 10 (preventative) or Section 09 05 16 (remedial), unless another coating is supplied, required, recommended, accepted by the by manufacturer for actual in-service conditions applicable to the project.
- C. Fluid-Applied Waterproofing / Crack Isolation Membrane:
 1. Products: Provide one of the following, or equal.
 - a. "RedGard" elastomeric membrane manufactured by Custom Building Products.
 - b. "Laticrete HydroBan" manufactured by LATICRETE International, Inc.
 - c. "Mapelastic AquaDefense" manufactured by Mapei Corp.
 2. Accessories:

- a. Primer: One-part waterproofing / crack isolation membrane diluted with 4 parts water and applied at a rate of 300 square feet per gallon of reduced material; or other substrate sealer or primer supplied, required, recommended, approved or accepted manufactured by the waterproofing/crack isolation membrane manufacturer.
 - b. Fiberglass Mesh: Provide manufacturer's standard alkali-resistant reinforcing mesh for changes of plane and for gaps 1/8-inch wide or greater.
 - c. Other Accessories: Provide other accessories and secondary items supplied, required, recommended, approved, or accepted manufactured by the waterproofing/crack isolation membrane manufacturer.
- D. Thin Bed Mortar (Thinset) Installations (horizontal applications between 3/32- and 3/16-inch thick after beat-in):
1. Description: Premium-grade (best quality grade), single-component, ultra-high-performance, polymer-modified Portland cement mortar conforming to A118.15 shear bond strength requirements.
 2. Application: Used for the installation of interior and exterior floor and wall vitreous, semi-vitreous or non-vitreous tile (ceramic, mosaic, quarry, and cement body tile); impervious porcelain tile; and natural stone veneer and stone tile.
 3. Products: Provide one of the following, or equal.
 - a. "FlexBond Crack Prevention Thin-Set Mortar" manufactured by Custom Building Products.
 - b. "254 Platinum" manufactured by LATICRETE International, Inc.
 - c. "Ultraflex 3" manufactured by Mapei Corp.
- E. Medium Bed Mortar Installations (horizontal applications between 3/8- and 3/4-inch thick after beat-in):
1. Description: Regular-setting, polymer-modified mortar conforming to A118.15 shear bond strength requirements.
 2. Application: Used for the installation of the installation of
 - a. large-format dimensional tile (greater than 12 by 12 inches);
 - b. inconsistent thickness natural stone; and
 - c. tiles and pavers having slight substrate irregularity.
 3. Products: Provide one of the following, or equal.
 - a. "Natural Stone & Large Tile Medium Mortar" manufactured by Custom Building Products.
 - b. "LATICRETE 4-XLT" manufactured by LATICRETE International, Inc.
 - c. "Ultraflex LFT" manufactured by Mapei Corp.
- F. Polymer-Modified Cementitious Sanded Grout:
1. Description: Premium-grade, pre-mixed, Portland cement sanded grout conforming to ANSI A118.7, and having a specifically-tailored, integrally-mixed antimicrobial agent.
 2. Application: Used for typical joints between 1/8- and 1/2-inch wide.
 3. Products: Provide one of the following, or equal.

- a. "Prism Ultimate Performance Grout" manufactured by Custom Building Products.
 - b. "LATICRETE PermaColor" manufactured by LATICRETE International, Inc.
 - c. "Ultracolor Plus FA" manufactured by Mapei Corp.
4. Colors: Indicated on the Drawings or selected by the Architect.
- G. Mix Water: Provide fresh, clean, clear, potable water from a domestic source. Water must conform to ASTM C 1602 and be free of oil, grease, waxy films, curing compounds, release agents, and other deleterious materials, including salts, acids, alkalis, organic materials, detergents, and other matter that might negatively affect tile quality, durability, appearance, or performance.

2.6 ACCESSORIES

- A. Trim Units: Coordinate with sizes and coursing of adjoining tile. Provide shapes indicated on the Drawings.
- B. Grout Release:
1. Description: Temporary, water soluble, pre-grout coating.
 2. Application: Used to provide protection against grout & mortar staining.
 3. Products: Provide one of the following, or equal.
 - a. "Aqua Mix Grout Release" manufactured by Custom Building Products.
 - b. "STONETECH Grout Release" manufactured by LATICRETE International, Inc.
 - c. "UltraCare Grout Release" manufactured by Mapei Corp.
- C. Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed tile and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering tile and grout surfaces.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints, which does not change either the color or appearance of installed grouts.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.7 MIXING

- A. Site Mixing: Batch mix installation materials in conformance with manufacturer's instructions and other requirements and recommendations, using manufacturer-recommended techniques and manufacturer-recommended mechanical mixing equipment, which must be clean and free of material from previously mixed batches before charging each subsequent batch.
1. Measure mix materials using only graduated mixing containers and calibrated mixing equipment. Shovels do not qualify as graduated mixing containers or calibrated equipment and are prohibited from measuring or dispensing mix materials.

2. Thoroughly agitate and stir mix materials to a uniform and smooth consistency suitable for proper installation.
3. Do not reduce, alter, or introduce foreign materials into mix materials, except in conformance with manufacturer's instructions and other requirements and recommendations.
4. Do not use caked or lumpy materials; or materials that are irregular, too thick or too thin, or that are partially set.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations, including dimensional tolerances and deflection criteria.
 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 3. Verify items penetrating tile are installed.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of installation, durability, appearance, or performance of furnished tiling.

2. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with leveling and patching compound. Apply, trowel, and float patching compound to achieve smooth, flat, hard surface. Prohibit traffic until patching compound is cured.
3. Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16. Provide ICRI concrete surface profile CSP 3 to CSP 5 (light to medium shotblast between 10 and 40 mils), unless otherwise explicitly required, recommended, or accepted in writing by the waterproofing manufacturer.
4. Vacuum-clean substrate.

3.3 INSTALLATION

A. General Requirements:

1. Install tile in conformance with the specified quality standards requirements using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set tile to line; plumb, level, and square without warp or lipping; with uniform, well-fitted joints and in alignment with adjacent construction
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed tile must be warrantable. Do not install, correct, or replace tile in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Install waterproofing/crack prevention membrane in conformance with ANSI A108.13 and the waterproofing/crack prevention manufacturer's written instructions to produce membrane of uniform thickness bonded securely to substrate.
2. Do not install tile over waterproofing/crack prevention membrane until membrane has cured and been tested to determine that it is watertight.
3. Install tile in conformance with the ANSI and TCNA quality standard publication requirements for wall installations.
4. Accurately form intersections and returns. Perform cutting and drilling without marring visible surfaces. Carefully grind cut edges abutting trim, finishes, 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.
5. Jointing Pattern: Lay tile in patterns as indicated on the Drawings.
 - a. Ensure tile are the same size and joints align when tile are installed against stone on floors, bases, walls, and trim.
 - b. Lay out and center tile in both directions in each space or on each wall area. Adjust to minimize cutting.
 - c. Provide uniform joint widths, unless otherwise indicated.
6. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, during installation..

- a. Locate joints in tile surfaces directly above joints in concrete substrates.
 - b. Prepare joints and apply sealants in conformance with the requirements in Section 07 92 00.
 - c. Do not saw-cut joints after installing stones
7. Thresholds: Install thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
8. Grout tile in conformance with the ANSI and TCNA quality standard publication requirements.
9. Grout Sealer: Apply grout sealer to cementitious grout joints in conformance with the grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile by wiping with soft cloth.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere tile to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible tile surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.

3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed tile in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to or against installed tile unless they are protected from damage, as accepted in writing by the Architect. Do not use installed tile as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Suspended acoustical ceiling panels.
2. Suspension system.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. CISCA: Ceilings & Interior Systems Construction Association.
2. ASW: American Steel and Wire Co.
3. SWG: Steel Wire Gauge.

B. Definitions:

1. Manufacturer: Means the acoustical ceiling manufacturer, unless otherwise indicated.
2. Ceiling: Means the ceiling finish and associated suspension systems.
3. Wire Gage (Steel Wire Gage): Means the diameter of steel wire, in inches, according to dimensions established by Washburn & Moen, Roebling, or American Steel and Wire Co.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate ceiling layout and installation with adjacent construction elements that penetrate ceilings, or is supported by them, including

1. light fixtures;
2. HVAC equipment;
3. fire-suppression system components;
4. partition assemblies; and

5. perimeter conditions.

B. Sequencing:

1. Schedule acoustical ceiling deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; and storage areas are broom- and vacuum-clean.
2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
3. Install acoustical ceilings only after penetrating items are installed.
4. After acoustical ceiling installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

C. Scheduling: Allow sufficient time in the construction schedule to acclimate acoustical ceilings to specified ambient conditions for at least 48 hours before installation begins.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:

- a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings:

- a. Submit dimensioned plans drawn to scale and showing acoustical ceiling layout, materials, joints, edge conditions, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
- b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.

3. Samples:

- a. Submit at least 8-inch square representative samples of each acoustical ceiling variety for each specified color and finish.
- b. Submit at least 8-inch long representative samples of each suspension system exposed tee, molding, and trim variety in each specified color and finish.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Coordination Drawings: Submit at least 1/4-inch scale dimensioned reflected ceiling plans showing the following items coordinated with each other, based on input from installers of each item involved.
 - a. Ceiling suspension system members.
 - b. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - c. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
2. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished acoustical ceilings.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Maintenance Material Submittals:

1. Before Final Completion, deliver to the Owner acoustical ceiling cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
2. Furnish at least 2 percent of the total installed for each acoustical ceiling type, color, composition, grade, finish, and variety, but not less than one box or open container.

D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical ceilings must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide acoustical ceilings having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.
2. Ceiling panels, other than acoustical panels, weighing more than 1/2-pound per square foot must be positively attached to ceiling suspension runners in conformance with California Building Code Section 1616A.1.21.

C. Quality Standards

1. Seismic Standard: Provide acoustical ceilings designed and installed to withstand the effects of earthquake motions in conformance with ASCE/SEI 7, *"Minimum Design Loads For Buildings and Other Structures"*; CISC publication, *"Seismic Construction Handbook"*; and California Building Code Sections 803.9.1.1, 1614, 1616A.1.20, and 2506.2.1.
2. Installation Standard: Comply with CISC publication *"Ceiling Systems Handbook"* requirements for installation.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing acoustical ceilings for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing acoustical ceilings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading acoustical ceiling installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 - 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective ceiling materials with undamaged new ceiling materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install acoustical ceilings only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Armstrong World Industries.
 - 2. CertainTeed Corp.
 - 3. USG Interiors, Inc.

2.3 ACOUSTICAL CEILING PANELS

- A. Description: Mineral fiber ceiling panels conforming to ASTM E 1264 Type XII (glass fiber base with membrane-faced overlay), Form 2 (cloth), Pattern E (lightly textured).
- B. Product: "SAND MICRO" manufactured by CertainTeed Corp., or equal.
- C. Requisite Properties:
 - 1. Style: "SHM-194", or equal.
 - 2. Size: 24 inches by 48 inches by 7/8-inch.
 - 3. Color: "White".
 - 4. Surface Finish: Factory-applied latex paint.
 - 5. Edge Detail: Reveal beveled.
- D. Performance Requirements:
 - 1. Minimum Noise Reduction Coefficient (NRC): At least NRC 0.50, when tested in conformance with ASTM E 492 and ASTM E 989.
 - 2. Minimum Ceiling Attenuation Class (CAC): At least CAC 35, when tested in conformance with ASTM E 492 and ASTM E 1414.

2.4 SUSPENSION SYSTEMS

- A. Description: Non-rated direct hung ceiling suspension system conforming to ASTM C 635 requirements for Heavy Duty structural classification.
- B. Product: "Reveal Beveled EZ Stab Classic" manufactured by CertainTeed Corp., or equal.
- C. Requisite Properties:
 - 1. Size: 15/16-inch bottom flange face dimension by 1-11/16-inch web height.
 - 2. Profile Type: Exposed tee.
 - 3. Material: Hot dip galvanized steel sheet.
 - 4. Finish: Manufacturer's standard shop-applied pre-treatment and baked enamel finish.
 - 5. Color: "White".

2.5 INSTALLATION MATERIALS

- A. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635 Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- B. Wire: Soft temper, zinc-coated, pre-stretched, galvanized carbon steel wire conforming to ASTM A 641 Class 3 or A coating and having a minimum yield-stress load of 3 times the design load.
 - 1. Hanger Wire: Minimum 0.106-inch diameter. (ASW12)
 - 2. Diagonal Bracing Wire: Minimum 0.106-inch diameter. (ASW12)
 - 3. Provide heavier gage hanger wire for ceiling systems heavier than 4 pounds per square foot.
- C. Compression Struts: Provide one of the following.
 - 1. Cold or hot rolled angles, loadbearing or non-loadbearing studs, EMT or rigid conduit, or black iron.
 - 2. Cold-rolled steel section with maximum L/R ratio of not more than 200.
- D. Engineered Compression Struts:
 - 1. Description: Pre-engineered telescoping seismic compression posts manufactured from heavy-wall galvanized tubing.
 - 2. Application: Manufactured compression struts may be provided in lieu of compression struts indicated above when installed in conformance with its manufacturer's instructions.
 - 3. Products: Provide one of the following, or equal.
 - a. "ARMSTRONG 5594 Ceiling Tile Compression Strut" manufactured by Armstrong World Industries, or equal.
 - b. "Donn Brand Compression Post VSA" manufactured by USG Interiors, Inc. (ICC ES Report No. ESR-1222), or equal.
- E. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 ACCESSORIES

- A. Seismic Clips:
 - 1. Description: 2-inch beam end retaining clip that joins main beam or cross tee to wall molding and web of grid with no visible pop rivets.
 - 2. Restrictions: Use of seismic clips is permitted only when specifically detailed on the Drawings. Alternative method of construction plan-review approval is required for use of seismic clips.
 - 3. Products: Provide one of the following, or equal.
 - a. "BERC 2" clips manufactured by Armstrong World Industries, or equal.
 - b. "ACM7" clips manufactured by USG Interiors, Inc., or equal.

- c. "CTSPC-2" clips manufactured by CertainTeed ICC- ES- 3336, or equal.
- B. Seismic Separation Joints: Provide ceiling system manufacturer's standard at seismic separation joints at ceiling locations where the contiguous area of non-broken ceiling is 2,500 square feet or greater.
- C. Perimeter Wall Molding: Provide the following manufactured by Armstrong World Industries, or equal, with prefinished exposed flanges matching suspension system.
 - 1. Angle Molding: "WA14-14" 7/8-inch by 7/8-inch flange ICC ES-3336 manufactured by Certain Teed, or equal.
 - 2. Shadow Molding Installed with Seismic Clips:
 - a. Application: Compatible with Seismic Rx and BERC 2 clips.
 - b. Product: "No. 7897" 15/16-inch flange by 15/16-inch high by 3/8-inch reveal hemmed edge molding.
 - 3. Channel Molding: "SM 1050", or equal, 15/16-inch flange by 1-1/4-inch high by 1/2-inch reveal hemmed edge molding ICC ES-3336 manufactured by Certain Teed, or equal.
- D. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify items penetrating acoustical ceilings are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install acoustical ceilings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed acoustical ceilings must be warrantable. Do not install, correct, or replace acoustical ceilings in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Suspend ceiling hangers from building's structural members.
 - a. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - b. Do not attach hangers to steel deck tabs. Do not attach hangers to steel roof deck. Attach hangers to structural members.
2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or ceiling suspension system.
3. Space hangers not more than 48 inches on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - b. Where width of ducts and other construction within ceiling plenums produce 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.
 - c. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by the quality standard publications.
4. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - a. Secure wire hangers to ceiling suspension members and to supports above with at least 3 tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure bracing wires to ceiling suspension members and to supports with at least 4 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 post installed anchors.
6. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 7. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - a. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - b. Mechanically-fasten moldings to substrates at intervals not more than 16 inches on center and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - c. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 8. Install ceiling panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - a. Arrange directionally patterned ceiling panels as indicated on reflected ceiling plans. Install panels with pattern running in one direction parallel to short axis of space.
 - b. For square-edged panels, install with edges fully hidden from view by flanges of suspension system runners and moldings.
 - c. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by ceiling panel manufacturer.
 - d. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach acoustical ceilings to supporting construction.
- D. Installation Tolerances: Ceilings must conform to the following tolerances, which are non-cumulative.
1. Maximum Out of Plane: Surfaces may not vary by more than 1/8-inch in 10 feet.
 2. Carrying Channel Maximum Out of Level: Not more than 1/8-inch in 12 feet,
 3. Main Runner Maximum Out of Level: Not more than 1/4-inch in 10 feet,
 4. Main Runner Maximum Deflection: Not more than L/360 of span,
 5. Maximum Misalignment of Main Runners: 0.015-inch.
 6. Maximum Misalignment of Intersection Members: 0.020-inch.
 7. Main Runner Bow, Camber, and Twist: Not more than 1/32-inch in 2 feet bow or camber; not more than one degree twist.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible surfaces in a manner that does not result any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed acoustical ceilings in place from deterioration, and damage until Substantial Completion.
- B. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 51 15 – ACOUSTICAL CLOUD CEILING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Suspended acoustical cloud ceiling assemblies.
2. Installation materials.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. Cisca: Ceilings & Interior Systems Construction Association.
2. ASW: American Steel and Wire Co.
3. SWG: Steel Wire Gauge.

B. Definitions:

1. Manufacturer: Means the acoustical ceiling manufacturer, unless otherwise indicated.
2. Ceiling: Means the ceiling finish and associated suspension systems.
3. Wire Gage (Steel Wire Gage): Means the diameter of steel wire, in inches, according to dimensions established by Washburn & Moen, Roebling, or American Steel and Wire Co.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate ceiling layout and installation with adjacent construction elements that penetrate ceilings, or is supported by them, including

1. light fixtures;
2. HVAC equipment;
3. fire-suppression system components;
4. partition assemblies; and
5. perimeter conditions.

B. Sequencing:

1. Schedule acoustical ceiling deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; and storage areas are broom- and vacuum-clean.
2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
3. Install acoustical ceilings only after penetrating items are installed.
4. After acoustical ceiling installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

C. Scheduling: Allow sufficient time in the construction schedule to acclimate acoustical ceilings to specified ambient conditions for at least 48 hours before installation begins.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data:

- a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs) and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.

2. Shop Drawings:

- a. Submit dimensioned plans drawn to scale and showing acoustical ceiling layout, materials, joints, edge conditions, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
- b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.

3. Samples:

- a. Submit at least 8-inch square representative samples of each acoustical ceiling variety for each specified color and finish.
- b. Submit at least 8-inch long representative samples of each suspension system exposed tee, molding, and trim variety in each specified color and finish.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Coordination Drawings: Submit at least 1/4-inch scale dimensioned reflected ceiling plans showing the following items coordinated with each other, based on input from installers of each item involved.
 - a. Ceiling suspension system members.
 - b. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - c. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
2. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished acoustical ceilings.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Maintenance Material Submittals:

1. Before Final Completion, deliver to the Owner acoustical ceiling cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
2. Furnish at least 2 percent of the total installed for each acoustical ceiling type, color, composition, grade, finish, and variety, but not less than one box or open container.

D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Acoustical ceilings must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide acoustical ceilings having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.
2. Ceiling panels, other than acoustical panels, weighing more than 1/2-pound per square foot must be positively attached to ceiling suspension runners in conformance with California Building Code Section 1616A.1.21.

C. Quality Standards

1. Seismic Standard: Provide acoustical ceilings designed and installed to withstand the effects of earthquake motions in conformance with ASCE/SEI 7, *"Minimum Design Loads For Buildings and Other Structures"*; CISC publication, *"Seismic Construction Handbook"*; and California Building Code Sections 803.9.1.1, 1614, 1616A.1.20, and 2506.2.1.
2. Installation Standard: Comply with CISC publication *"Ceiling Systems Handbook"* requirements for installation.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing acoustical ceilings for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing acoustical ceilings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading acoustical ceiling installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 - 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective ceiling materials with undamaged new ceiling materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install acoustical ceilings only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 ACOUSTICAL CLOUD CEILING ASSEMBLIES

- A. Product: "Soft Leaf Ceiling Acoustic Clouds" manufactured by Plantscape, Inc., or equal.
- B. Requisite Properties:
 - 1. Size: Indicated on the Drawings.
 - 2. Color: "SND107 Grasshopper".

2.3 COMPONENTS

2.4 INSTALLATION MATERIALS

- A. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- B. Wire: Soft temper, zinc-coated, pre-stretched, galvanized carbon steel wire conforming to ASTM A 641 Class 3 or A coating and having a minimum yield-stress load of 3 times the design load.
 - 1. Hanger Wire: Minimum 0.106-inch diameter. (12-gage ASW)
 - 2. Diagonal Bracing Wire: Minimum 0.106-inch diameter. (12-gage ASW)
 - 3. Provide heavier gage hanger wire for ceiling systems heavier than 4 pounds per square foot.
- C. Compression Struts:
 - 1. Cold or hot rolled angles, loadbearing or non-loadbearing studs, EMT or rigid conduit, or black iron.
 - 2. Cold-rolled steel section with maximum L/R ratio of 200.
- D. Engineered Compression Struts:
 - 1. Description: Pre-engineered telescoping seismic compression posts manufactured from heavy-wall galvanized tubing.
 - 2. Application: Manufactured compression struts may be provided in lieu of compression struts indicated above when installed in conformance with its manufacturer's instructions.
 - 3. Products: "ARMSTRONG 5594 Ceiling Tile Compression Strut" manufactured by Armstrong World Industries, or equal.
- E. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 ACCESSORIES

- A. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify items penetrating acoustical ceilings are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install acoustical ceilings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed acoustical ceilings must be warrantable. Do not install, correct, or replace acoustical ceilings in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. Suspend ceiling hangers from building's structural members.
 - a. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or

- adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
- b. Do not attach hangers to steel deck tabs. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 2. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or ceiling suspension system.
 3. Space hangers not more than 48 inches on center along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - a. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - b. Where width of ducts and other construction within ceiling plenums produce 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.
 - c. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by the quality standard publications.
 4. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - a. Secure wire hangers to ceiling suspension members and to supports above with at least 3 tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure bracing wires to ceiling suspension members and to supports with at least 4 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 post installed anchors.
 6. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
 7. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of ceiling panels.
 8. Install ceiling panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - a. Arrange directionally patterned ceiling panels as indicated on reflected ceiling plans. Install panels with pattern running in one direction parallel to short axis of space.
 - b. For square-edged panels, install with edges fully hidden from view by flanges of suspension system runners and moldings.
 - C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach acoustical ceilings to supporting construction.

- D. Installation Tolerances: Ceilings must conform to the following tolerances, which are non-cumulative.
1. Maximum Out of Plane: Surfaces may not vary by more than 1/8-inch in 10 feet.
 2. Carrying Channel Maximum Out of Level: Not more than 1/8-inch in 12 feet,
 3. Main Runner Maximum Out of Level: Not more than 1/4-inch in 10 feet,
 4. Main Runner Maximum Deflection: Not more than L/360 of span,
 5. Maximum Misalignment of Main Runners: 0.015-inch.
 6. Maximum Misalignment of Intersection Members: 0.020-inch.
 7. Main Runner Bow, Camber, and Twist: Not more than 1/32-inch in 2 feet bow or camber; not more than one degree twist.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible surfaces in a manner that does not result any warranty or guarantee becoming void.
1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.

- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed acoustical ceilings in place from deterioration, and damage until Substantial Completion.
- B. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 62 62 – METAL FLOORING TRANSITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal flooring transitions.
 - 2. Installation materials.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the flooring transition manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished flooring transitions.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Maintenance Material Submittals:

1. Before Final Completion, deliver to the Owner flooring transition cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
2. Furnish at least 2 percent of the total installed for each flooring transition type, color, composition, grade, finish, and variety, but not less than one unopened box or container.

D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Flooring transitions must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, transitions, and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.5 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items as shipped, upright in their original containers, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
 - 1. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer
 - 2. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations.
 - 1. Avoid damage to containers and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective flooring transitions with undamaged new flooring transitions that do not exhibit deterioration, damage, or defects, including rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:

1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 METAL FLOORING TRANSITIONS

- A. Foot Traffic Flooring transitions:
1. Description: Metal profiles designed to provide a smooth transition between tile coverings and flooring or finished concrete at lower elevations.
 2. Product: "VINPRO-U VPU 50" manufactured by Schluter Systems, or equal.
 3. Material: Stainless steel.
- B. Edge Strips:
1. Description: L-shaped profile with 1/8-inch wide visible surface and integrated trapezoid-perforated anchoring leg and grout joint spacer.
 2. Product: "Schluter-SCHIENE" or "Schluter-JOLLY" manufactured by Schluter Systems, or equal.
 3. Material: Stainless steel.

2.3 INSTALLATION MATERIALS

- A. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions,

including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.

B. Adhesive:

1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of installation; and for adequate bonding of flooring transitions to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected fire-resistance ratings.
2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each flooring transition application.

2.4 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with flooring transition adhesion, appearance, or performance.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install flooring transitions using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended transitions and techniques.
 - 2. Only install flooring transitions under conditions that ensure finishes are free from blemishes and defects.
 - 3. Completed work must match approved samples and mockups, as accepted by the Architect.
 - 4. Installed flooring transitions must be warrantable. Do not install, correct, or replace flooring transitions in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. Apply metal base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 2. Install metal base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 3. Tightly adhere metal base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of metal base with manufacturer's recommended adhesive filler material.
- C. Interface with Adjacent Items: Provide materials, components, and transitions normally furnished or necessary to securely adhere flooring transitions to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;

2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: After installation, correction, and repair are complete, remove strippable film or other temporary protection. Promptly remove from exposed metal surfaces anything that might interfere with uniform oxidation.
1. Clean all visible flooring transition surfaces in a manner that does not result in any warranty or guarantee becoming void.
 2. Use cleaning materials and transitions supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 3. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 4. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 5. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be satisfactorily cleaned to the reasonable satisfaction of the Architect, whose decision is final.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed flooring transitions in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed flooring transitions unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed flooring transitions as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 65 13 – RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient wall base.
2. Resilient floor transitions.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 29 00 for definition of “permanent enclosure”.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the resilient base or accessory manufacturer, as the context admits, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:

1. Schedule resilient base and accessory deliveries to the project site only after the building is enclosed with a permanent enclosure; “wet work” within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Final light fixtures must be completely installed and energized before beginning installation.
3. Install resilient base and accessories only after all other finishing operations are complete, especially overhead finishes.
4. After resilient base and accessory installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

B. Scheduling:

1. Acclimation: Allow sufficient time in the construction schedule to acclimate resilient base and accessories and installation materials to specified ambient conditions for at least 48 hours before installation begins.
2. Primer Installation: Resilient base and accessories must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished resilient base and accessories.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals:
 1. Before Final Completion, deliver to the Owner resilient base and accessory cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 2. Furnish at least 2 percent of the total installed for each resilient base and accessory type, color, composition, grade, finish, and variety, but not less than one unopened box or container.
- D. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Resilient base and accessories must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: base having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.
2. Radiant Flux Classification: resilient accessories having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.

C. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing resilient base and accessories for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing resilient base and accessories for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading resilient base and accessory installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items as shipped, upright in their original containers, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
 - 1. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer
 - 2. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations.
 - 1. Avoid damage to containers and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective resilient base and accessories with undamaged new resilient base and accessories that do not exhibit deterioration, damage, or defects, including rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install resilient base and accessories only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Surface Conditions: Surfaces receiving resilient base and accessories must be dry. Install resilient base and accessories only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 - 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 - 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.
- C. Other Conditions: Do not apply resilient base and accessories where dust is generated, or liquids are sprayed.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.

5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

A. Manufacturers: Provide products manufactured by one of the following, or equal.

1. Tarkett USA.
2. Roppe Corporation.
3. Burke.

2.3 RESILIENT WALL BASE

A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 RESILIENT FLOOR TRANSITION MOLDINGS

A. Description: PVC transitional molding profiles designed to finish edge of floor covering material to base and accessory surface and to transition between floor covering materials.

B. Products: "Finishing Accessories" manufactured by Johnsonite, or equal.

1. Material to Floor Reducers: Model No. "CRS-XX" and "RRS-XX" reducers, or equal.
2. Material to Material Reducers: Model No. "SSR-XX" reducers, or equal.
3. Slim Line Transitions: Model No. "SLTC-XX" transitions, or equal.
4. Edge Guards: Model No. "EG-XX" guards, or equal.

5. Wheeled Traffic Transitions: Model No. "CTA-XX" transitions, or equal.

C. Requisite Properties:

1. Minimum Sizes: Indicated on the Drawings.
2. Colors: Selected by the Architect.

2.5 INSTALLATION MATERIALS

A. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.

B. Adhesive:

1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of installation; and for adequate bonding of resilient base and accessories to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each resilient base and accessory type and application.
3. Provide hard-set adhesive supplied, required, recommended, or accepted by the manufacturer under resilient base and accessories subject to concentrated static or dynamic rolling loads.

2.6 ACCESSORIES

A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or

accepted by the manufacturer for the actual in-service conditions applicable to the project.

2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with resilient base and accessory adhesion, appearance, or performance.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

A. General Requirements:

1. Install resilient base and accessories using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install resilient base and accessories under conditions that ensure finishes are free from blemishes and defects.
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed resilient base and accessories must be warrantable. Do not install, correct, or replace resilient base and accessories in a manner that results in any warranty or guarantee becoming void.

B. Resilient Base Special Techniques:

1. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
2. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
3. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
4. Do not stretch resilient base during installation.
5. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
6. Use straight pieces of maximum lengths possible to form corners; form without producing discoloration (whitening) at bends.

- C. Transitional Moldings Special Techniques: Butt resilient transitional moldings to adjacent materials, and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient base and accessory that would otherwise be exposed.
- D. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere resilient base and accessories to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible resilient base and accessory surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed resilient base and accessories in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed resilient base and accessories unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed resilient base and accessories as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 65 16 – RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient sheet flooring.
2. Surface preparation.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish flooring; and for remedial MVER products.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. ICRI: International Concrete Repair Institute, Inc.
2. MVER: Moisture Vapor Emission Rate.
3. RFCI: Resilient Floor Covering Institute.

B. Definitions:

1. Manufacturer: Means the resilient sheet flooring manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Concrete Substrates:
 - a. Verify chemical and adhesive compatibility of selected flooring adhesives with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
 - b. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning

or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the flooring manufacturer.

2. Wood Substrates: Verify all wood sub floors are double-layer construction, are suspended at least 18 inches above grade, and have adequate cross-ventilation.

B. Preinstallation Meeting:

1. Resilient sheet flooring manufacturer's representative and installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, resilient sheet flooring manufacturer's representatives and installers, and the entities and individuals responsible for conducting concrete substrate testing.
3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
4. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including subfloor surface flatness and levelness, and special details and conditions that might affect installation.
5. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed resilient sheet flooring. Resolve each condition.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Schedule resilient sheet flooring deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install resilient sheet flooring only after substrate is cured to a condition of equilibrium; is sufficiently dry to bond with resilient sheet flooring adhesives; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
3. Final light fixtures must be completely installed and energized before beginning installation.
4. Install resilient sheet flooring only after penetrating items are installed.
5. Install resilient sheet flooring only after all other finishing operations are complete, especially overhead finishes.
6. After resilient sheet flooring installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

D. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
2. Acclimation: Allow sufficient time in the construction schedule to acclimate resilient sheet flooring and installation materials to specified ambient conditions for at least 48 hours before installation begins.
3. Primer Installation: Resilient sheet flooring must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
4. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling traffic for at least 72 hours.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing resilient sheet flooring custom patterns and inlays, and seam layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
3. Material Samples:
 - a. Submit at least 8-inch square representative samples of each resilient sheet flooring color, finish, and variety.
 - b. Submit at least 8-inch long representative samples of each welding rod selected or required for each resilient sheet flooring color, finish, and variety.
4. Seam Samples:
 - a. Submit at least 8- by 10-inch samples of each seam required for each resilient sheet flooring color, finish, and variety, with seam in center of each sample.
 - b. Samples are representative samples of actual finishes, and must be prepared by the same installer's personnel designated to perform the work of this specification section.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished resilient sheet flooring.

- a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for resilient sheet flooring maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Maintenance Material Submittals:
 1. Before Final Completion, deliver to the Owner resilient sheet flooring cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 2. Furnish at least 2 percent of the total installed for each resilient sheet flooring type, color, composition, grade, finish, and variety, but not less than one unopened box or container.
- E. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 1. Resilient sheet flooring must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.

2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Resilient sheet flooring must be stable, firm, and slip resistant, conforming to the requirements of California Building Code Section 11B-302.1
2. Radiant Flux Classification: Provide resilient sheet flooring having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.
3. Allowable Static Coefficient of Friction Value (SCOF): At least 0.6 for level surfaces and at least 0.8 for sloped surfaces, when measured in conformance with ASTM D 2047.
4. Allowable Dynamic Coefficient of Friction Value (DCOF): Between 0.35 and 0.45, when measured in conformance with ANSI B101.3 under wet conditions.

C. Quality Standards:

1. Resilient Sheet Flooring Installation Standard: Comply with Resilient Floor Covering Institute publication RFCI IP #1, *"Recommended Installation Practice for Homogeneous Sheet Flooring, Fully-Adhered"* requirements that apply to each in-service condition indicated.
2. Material Standard: Resilient sheet flooring must be independently tested and certified by Scientific Certification Systems (SCS) in conformance with FloorScore requirements for indoor air quality emissions.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing resilient sheet flooring for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing resilient sheet flooring for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading resilient sheet flooring installers.

- E. Custom Patterns and Inlays: Resilient sheet flooring must be laser-cut. Field cutting is prohibited.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 - 3. Sheet products must be tightly rolled face out on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
 - 4. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 - 1. Avoid damage to packaging and containers, and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective resilient sheet flooring materials with undamaged new resilient sheet flooring materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install resilient sheet flooring only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Surface Conditions: Surfaces receiving resilient sheet flooring must be dry. Install resilient sheet flooring only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 - 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 - 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.

5. Preference is given to Declare labels designated as Red List Free.

E. Low-Emitting Materials criteria:

1. VOC content criteria:

- a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
- b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 VINYL SHEET FLOORING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.3 SURFACE PREPARATION

- A. Substrate Testing and Surface Preparation: Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16.

2.4 INSTALLATION MATERIALS

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16, unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Moisture Vapor Transmission Reduction Coating: Specified in Section 03 35 10 (preventative) or Section 09 05 16 (remedial), unless another coating is supplied, required, recommended, accepted by the by manufacturer for actual in-service conditions applicable to the project.
- C. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.

D. Adhesive:

1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of resilient sheet flooring installation; and for adequate bonding of resilient sheet flooring to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each resilient sheet flooring type and application.
3. Provide hard-set adhesive supplied, required, recommended, or accepted by the manufacturer under resilient sheet flooring subject to concentrated static or dynamic rolling loads.

E. Integral Flash Cove Base Accessories: Provide the following manufactured by Johnsonite, or equal.

1. Cove Filler Strips:

- a. 1-3/4-inch Radius: "Model No. CFS-00", or equal.
- b. 1-1/4-inch Radius: "Model No. CFS-00-A", or equal.
- c. One-inch Radius: "Model No. CFS-00-M", or equal.

2. Cove Caps: "Model No. SCC-55-A", or equal.

F. Welding Rods:

1. Description: Manufacturer's standard solid-strand, solidified adhesive, through-color welding rods. Match flooring color, pattern, and appearance.
2. Colors: Indicated on the Drawings or selected by the Architect.
3. Requisite Properties:
 - a. Provide matching solid colors for solid color flooring.
 - b. Provide pattern-matching non-solid colors for patterned flooring.

2.5 ACCESSORIES

A. Subfloor Leveler System:

1. Products: Provide the following manufactured by Johnsonite, or equal.
 - a. Reduces 1/8-inch to Zero: "Model No. LS-40-F", or equal.
 - b. Reduces 1/4-inch to Zero (can be cut at score line to reduce height as indicated): "Model No. LS-40", or equal.
 - c. Reduces 1/4-inch to Zero (leveled edge for tack strip installation): "Model No. LS-40-K", or equal.
 - d. Reduces 3/8-inch to Zero (can be cut at score line to reduce height as indicated): "Model No. LS-40-D", or equal.
 - e. Reduces 1/2-inch to Zero (can be cut at score line to reduce height as indicated): "Model No. LS-40-E", or equal.
 - f. Reduces 3/4-inch to Zero: "Model No. LS-40-G", or equal.
 - g. Reduces 3/8-inch to 1/4-inch (can be used alone or with LS-40 to extend transition): "Model No. LS-40-B", or equal.

- h. Reduces 1/2-inch to 3/8-inch (can be used alone or with Model Nos. "LS-40-D" or "LS-40-D" to extend transition): "Model No. LS-40-C", or equal.
- B. Leveling Paper:
 - 1. Application: Used to align finish surfaces of 2.0mm and 3.0mm flooring.
 - 2. Description: Kraft or felt paper supplied, required, recommended, or accepted by the manufacturer.
- C. Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed resilient sheet flooring and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering resilient sheet flooring surfaces.
- D. Floor Polish: Protective liquid polish products supplied, required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 - 3. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with resilient sheet flooring adhesion, appearance, or performance.
 - 4. Verify items penetrating resilient sheet flooring are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and resilient sheet flooring installation. Control and collect dust produced by grinding operations.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage, and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of the installation, durability, appearance, or performance of either the furnished resilient sheet flooring or adhesives.
2. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with patch and fill materials. Apply, trowel, and float patch material to achieve smooth, flat, hard surface. Prohibit traffic until patch material is cured.
3. Perform testing, corrective work, and substrate preparation specified in Section 09 05 16.
4. Vacuum-clean substrate.

C. Bond Test: Perform and document bond tests as required, recommended, or accepted by the manufacturer, must be performed and documented before beginning installation.

3.3 INSTALLATION

A. General Requirements:

1. Install resilient sheet flooring using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install resilient sheet flooring under conditions that ensure finishes are free from blemishes and defects.
3. Completed work must match approved samples and mockups, as accepted by the Architect.

4. Installed resilient sheet flooring must be warrantable. Do not install, correct, or replace resilient sheet flooring in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Scribe, cut, and fit resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
2. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings. Extend resilient sheet flooring to centerline of doors in the closed position.
3. 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 pencil, chalk, or other nonpermanent, non-staining marking device. The use of markers is prohibited.
4. Adhere resilient sheet flooring to substrate 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.
5. For seamless resilient sheet flooring installation, rout seams and weld together with coordinated color heat welding rod in conformance with the manufacturer's instructions.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere resilient sheet flooring to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible resilient sheet flooring surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed resilient sheet flooring in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed resilient sheet flooring unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed resilient sheet flooring as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 65 23 – RESILIENT PLANK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient plank flooring.
2. Surface preparation.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish flooring; and for remedial MVER products.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. ICRI: International Concrete Repair Institute, Inc.
2. MVER: Moisture Vapor Emission Rate.
3. RFCI: Resilient Floor Covering Institute.

B. Definitions:

1. Manufacturer: Means the resilient plank flooring manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Concrete Substrates:

- a. Verify chemical and adhesive compatibility of selected flooring adhesives with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
- b. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning

or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the flooring manufacturer.

2. Wood Substrates: Verify all wood sub floors are double-layer construction, are suspended at least 18 inches above grade, and have adequate cross-ventilation.

B. Preinstallation Meeting:

1. Resilient plank flooring manufacturer's representative and installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, resilient plank flooring manufacturer's representatives and installers, and the entities and individuals responsible for conducting concrete substrate testing.
3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
4. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including subfloor surface flatness and levelness, and special details and conditions that might affect installation.
5. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed resilient plank flooring. Resolve each condition.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Schedule resilient plank flooring deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install resilient plank flooring only after substrate is cured to a condition of equilibrium; is sufficiently dry to bond with resilient plank flooring adhesives; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
3. Final light fixtures must be completely installed and energized before beginning installation.
4. Install resilient plank flooring only after penetrating items are installed.
5. Install resilient plank flooring only after all other finishing operations are complete, especially overhead finishes.
6. After resilient plank flooring installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

D. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
2. Acclimation: Allow sufficient time in the construction schedule to acclimate resilient plank flooring and installation materials to specified ambient conditions for at least 48 hours before installation begins.
3. Primer Installation: Resilient plank flooring must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
4. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling traffic for at least 72 hours.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing resilient plank flooring custom patterns and inlays, and seam layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
3. Samples: Submit at least 8-inch square representative samples of each resilient plank flooring color, finish, and variety.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished resilient plank flooring.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for resilient plank flooring maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Maintenance Material Submittals:
 - 1. Before Final Completion, deliver to the Owner resilient plank flooring cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 - 2. Furnish at least 2 percent of the total installed for each resilient plank flooring type, color, composition, grade, finish, and variety, but not less than one unopened box or container.
- E. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Resilient plank flooring must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Regulatory Requirements:
 - 1. Resilient plank flooring must be stable, firm, and slip resistant, conforming to the requirements of California Building Code Section 11B-302.1

2. Radiant Flux Classification: Provide resilient plank flooring having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.
3. Allowable Static Coefficient of Friction Value (SCOF): At least 0.6 for level surfaces and at least 0.8 for sloped surfaces, when measured in conformance with ASTM D 2047.
4. Allowable Dynamic Coefficient of Friction Value (DCOF): Between 0.35 and 0.45, when measured in conformance with ANSI B101.3 under wet conditions.

C. Quality Standards:

1. Resilient Plank Flooring Installation Standard: Comply with Resilient Floor Covering Institute publication RFCI IP #2, "*Recommended Installation Practice for Vinyl Composition Plank (VCT)*" requirements that apply to each in-service condition indicated.
2. Material Standard: Resilient plank flooring must be independently tested and certified by Scientific Certification Systems (SCS) in conformance with FloorScore requirements for indoor air quality emissions.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing resilient plank flooring for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing resilient plank flooring for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading resilient plank flooring installers.

E. Custom Patterns and Inlays: Resilient plank flooring must be laser-cut. Field cutting is prohibited.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

1. Furnish adequate dunnage and bracing during storage.
2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.

3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective resilient plank flooring materials with undamaged new resilient plank flooring materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install resilient plank flooring only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 1. Surface Conditions: Surfaces receiving resilient plank flooring must be dry. Install resilient plank flooring only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.

- 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 1. Bentley Floor.
 2. Interface Inc.

2.3 RESILIENT PLANK FLOORING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 SURFACE PREPARATION

- A. Substrate Testing and Surface Preparation: Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16.

2.5 INSTALLATION MATERIALS

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16, unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Moisture Vapor Transmission Reduction Coating: Specified in Section 03 35 10 (preventative) or Section 09 05 16 (remedial), unless another coating is supplied, required, recommended, accepted by the by manufacturer for actual in-service conditions applicable to the project.
- C. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
- D. Adhesive:

1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of resilient plank flooring installation; and for adequate bonding of resilient plank flooring to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each resilient plank flooring type and application.
3. Provide hard-set adhesive supplied, required, recommended, or accepted by the manufacturer under resilient plank flooring subject to concentrated static or dynamic rolling loads.

2.6 ACCESSORIES

- A. Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed resilient plank flooring and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering resilient plank flooring surfaces.
- B. Floor Polish: Protective liquid polish products supplied, required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 3. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with resilient plank flooring adhesion, appearance, or performance.
 4. Verify items penetrating resilient plank flooring are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and resilient plank flooring installation. Control and collect dust produced by grinding operations.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage, and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of the installation, durability, appearance, or performance of either the furnished resilient plank flooring or adhesives.
2. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with patch and fill materials. Apply, trowel, and float patch material to achieve smooth, flat, hard surface. Prohibit traffic until patch material is cured.
3. Perform testing, corrective work, and substrate preparation specified in Section 09 05 16.
4. Vacuum-clean substrate.

C. Bond Test: Perform and document bond tests as required, recommended, or accepted by the manufacturer, must be performed and documented before beginning installation.

3.3 INSTALLATION

A. General Requirements:

1. Install resilient plank flooring using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install resilient plank flooring under conditions that ensure finishes are free from blemishes and defects.

3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed resilient plank flooring must be warrantable. Do not install, correct, or replace resilient plank flooring in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Scribe, cut, and fit resilient plank flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
2. Extend resilient plank flooring into toe spaces, door reveals, closets, and similar openings. Extend resilient plank flooring to centerline of doors in the closed position.
3. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient plank flooring as marked on substrates. Use pencil, chalk, or other nonpermanent, non-staining marking device. The use of markers is prohibited.
4. Adhere resilient plank flooring to substrate 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.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere resilient plank flooring to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible resilient plank flooring surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed resilient plank flooring in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed resilient plank flooring unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed resilient plank flooring as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 65 36 – STATIC CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Static dissipative tile flooring.
2. Surface preparation.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish flooring; and for remedial MVER products.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. ICRI: International Concrete Repair Institute, Inc.
2. MVER: Moisture Vapor Emission Rate.
3. RFCI: Resilient Floor Covering Institute.

B. Definitions:

1. Manufacturer: Means the resilient tile flooring manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Concrete Substrates:
 - a. Verify chemical and adhesive compatibility of selected flooring adhesives with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
 - b. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning

or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the flooring manufacturer.

2. Wood Substrates: Verify all wood sub floors are double-layer construction, are suspended at least 18 inches above grade, and have adequate cross-ventilation.

B. Preinstallation Meeting:

1. Resilient tile flooring manufacturer's representative and installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, resilient tile flooring manufacturer's representatives and installers, and the entities and individuals responsible for conducting concrete substrate testing.
3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
4. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including subfloor surface flatness and levelness, and special details and conditions that might affect installation.
5. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed resilient tile flooring. Resolve each condition.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Schedule resilient tile flooring deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install resilient tile flooring only after substrate is cured to a condition of equilibrium; is sufficiently dry to bond with resilient tile flooring adhesives; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
3. Final light fixtures must be completely installed and energized before beginning installation.
4. Install resilient tile flooring only after penetrating items are installed.
5. Install resilient tile flooring only after all other finishing operations are complete, especially overhead finishes.
6. After resilient tile flooring installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

D. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.
2. Acclimation: Allow sufficient time in the construction schedule to acclimate resilient tile flooring and installation materials to specified ambient conditions for at least 48 hours before installation begins.
3. Primer Installation: Resilient tile flooring must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
4. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling traffic for at least 72 hours.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing resilient tile flooring custom patterns and inlays, and seam layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
3. Samples: Submit at least 8-inch square representative samples of each resilient tile flooring color, finish, and variety.

B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished resilient tile flooring.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for resilient tile flooring maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Maintenance Material Submittals:
 - 1. Before Final Completion, deliver to the Owner resilient tile flooring cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 - 2. Furnish at least 2 percent of the total installed for each resilient tile flooring type, color, composition, grade, finish, and variety, but not less than one unopened box or container.
- E. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Resilient tile flooring must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- B. Regulatory Requirements:
 - 1. Resilient tile flooring must be stable, firm, and slip resistant, conforming to the requirements of California Building Code Section 11B-302.1

2. Radiant Flux Classification: Provide resilient tile flooring having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.
3. Allowable Static Coefficient of Friction Value (SCOF): At least 0.6 for level surfaces and at least 0.8 for sloped surfaces, when measured in conformance with ASTM D 2047.
4. Allowable Dynamic Coefficient of Friction Value (DCOF): Between 0.35 and 0.45, when measured in conformance with ANSI B101.3 under wet conditions.

C. Quality Standards:

1. Resilient Tile Flooring Installation Standard: Comply with Resilient Floor Covering Institute publication RFCI IP #2, "*Recommended Installation Practice for Vinyl Composition Tile (VCT)*" requirements that apply to each in-service condition indicated.
2. Material Standard: Resilient tile flooring must be independently tested and certified by Scientific Certification Systems (SCS) in conformance with FloorScore requirements for indoor air quality emissions.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing resilient tile flooring for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing resilient tile flooring for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading resilient tile flooring installers.

E. Custom Patterns and Inlays: Resilient tile flooring must be laser-cut. Field cutting is prohibited.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.

3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective resilient tile flooring materials with undamaged new resilient tile flooring materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install resilient tile flooring only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 1. Surface Conditions: Surfaces receiving resilient tile flooring must be dry. Install resilient tile flooring only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.

- 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 1. Armstrong World Industries.
 2. Shaw Industries Group, Inc.
 3. Johnsonite.

2.3 VINYL COMPOSITION TILE FLOORING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 SURFACE PREPARATION

- A. Substrate Testing and Surface Preparation: Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16.

2.5 INSTALLATION MATERIALS

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16, unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Moisture Vapor Transmission Reduction Coating: Specified in Section 03 35 10 (preventative) or Section 09 05 16 (remedial), unless another coating is supplied, required, recommended, accepted by the by manufacturer for actual in-service conditions applicable to the project.
- C. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
- D. Adhesive:

1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of resilient tile flooring installation; and for adequate bonding of resilient tile flooring to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each resilient tile flooring type and application.
3. Provide hard-set adhesive supplied, required, recommended, or accepted by the manufacturer under resilient tile flooring subject to concentrated static or dynamic rolling loads.

2.6 ACCESSORIES

- A. Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on the installed resilient tile flooring and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering resilient tile flooring surfaces.
- B. Floor Polish: Protective liquid polish products supplied, required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 3. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with resilient tile flooring adhesion, appearance, or performance.
 4. Verify items penetrating resilient tile flooring are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and resilient tile flooring installation. Control and collect dust produced by grinding operations.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage, and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of the installation, durability, appearance, or performance of either the furnished resilient tile flooring or adhesives.
2. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with patch and fill materials. Apply, trowel, and float patch material to achieve smooth, flat, hard surface. Prohibit traffic until patch material is cured.
3. Perform testing, corrective work, and substrate preparation specified in Section 09 05 16.
4. Vacuum-clean substrate.

C. Bond Test: Perform and document bond tests as required, recommended, or accepted by the manufacturer, must be performed and documented before beginning installation.

3.3 INSTALLATION

A. General Requirements:

1. Install resilient tile flooring using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install resilient tile flooring under conditions that ensure finishes are free from blemishes and defects.

3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed resilient tile flooring must be warrantable. Do not install, correct, or replace resilient tile flooring in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Scribe, cut, and fit resilient tile flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
2. Extend resilient tile flooring into toe spaces, door reveals, closets, and similar openings. Extend resilient tile flooring to centerline of doors in the closed position.
3. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient tile flooring as marked on substrates. Use pencil, chalk, or other nonpermanent, non-staining marking device. The use of markers is prohibited.
4. Adhere resilient tile flooring to substrate 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.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere resilient tile flooring to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible resilient tile flooring surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed resilient tile flooring in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed resilient tile flooring unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed resilient tile flooring as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 68 13 – TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Modular carpet tile.
2. Surface preparation.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 03 35 10 for concrete flatwork finishing and curing; and for preventative MVER products.
3. Section 09 05 16 for preparation of concrete slabs for finish carpet; and for remedial MVER products.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. CRI: The Carpet and Rug Institute, Inc.
2. ICRI: International Concrete Repair Institute, Inc.
3. MVER: Moisture Vapor Emission Rate.

B. Definitions:

1. Manufacturer: Means the carpet manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected carpet adhesives with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
2. Coordinate existing concrete subfloor surface flatness and levelness with ACI 117 requirements, measured in conformance with ASTM E 1155 (3D laser scanning or Allen Face F-Meter methods), and tolerances required, recommended, or accepted by the flooring manufacturer.

B. Preinstallation Meeting:

1. Carpet manufacturer's representative and installer must attend the preinstallation meeting specified in specification section 03 35 10.
2. Schedule a separate additional preinstallation meeting between the Contractor, the Architect, carpet manufacturer's representatives and installers, and the entities and individuals responsible for conducting concrete substrate testing.
3. Hold the meeting after submittal approval and at least 10 business days before beginning installation.
4. During the meeting, review the Contract Documents, submittals, project conditions, and installation sequence and methods, including subfloor surface flatness and levelness, and special details and conditions that might affect installation.
5. Identify and discuss adverse or unfavorable conditions detrimental to protecting stored materials or to installation; or to the quality, durability, appearance, or performance of installed carpet. Resolve each condition.
6. Finalize construction schedule.
7. Record significant discussions and distribute meeting minutes. Do not begin installation until disagreements are successfully resolved to the satisfaction of all parties.

C. Sequencing:

1. Schedule carpet deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Install carpet only after substrate is cured to a condition of equilibrium; is sufficiently dry to bond with carpet adhesives; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer. Provide chemically and adhesively compatible treatment when required or necessary to reduce pH and MVER to within allowable limits required, recommended, or accepted by the manufacturer.
3. Final light fixtures must be completely installed and energized before beginning installation.
4. Install carpet only after penetrating items are installed.
5. Install carpet only after all other finishing operations are complete, especially overhead finishes.
6. After carpet installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

D. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.

2. Acclimation: Allow sufficient time in the construction schedule to acclimate carpet and installation materials to specified ambient conditions for at least 48 hours before installation begins.
3. Primer Installation: Carpet must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.
4. Access Restrictions: Close spaces during installation; keep closed to foot traffic after installation for at least 48 hours and to rolling traffic for at least 72 hours.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing carpet and seam layouts.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
 3. Samples: Submit at least 8-inch square representative samples of each carpet color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished carpet.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals:
 1. Before Final Completion, deliver to the Owner extra stock materials to replace those worn or damaged as a result of normal occupancy.
 2. Furnish at least 2 percent of the total installed for each carpeting type, color, composition, grade, finish, and variety, but not less than one unopened gallon or container.

3. Submit manufacturer-recommended cleaning materials, accessories, and manufacturer's instructions and other requirements and recommendations for maintenance and cleaning of carpet surfaces, including a comprehensive list of known chemicals that should not come into contact with carpet surfaces.

D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Carpet must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

A. Regulatory Requirements:

1. Radiant Flux Classification: Provide carpet having an average critical radiant flux value of at least 0.45 (Class I), when tested in conformance with ASTM E 648.
2. Carpeting must conform to the requirements of California Building Code Section 11B-302.2
3. Carpet must be securely attached and must have a firm cushion, pad, or backing or no cushion or pad. It must have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height must be 1/2-inch maximum.
4. Exposed edges must be fastened to floor surfaces and must have trim on the entire length. Carpet edges must conform to the requirements of California Building Code Section 11B-303.

B. Quality Standards:

1. Installation Standard: Comply with The Carpet and Rug Institute publication CRI 104, *"Standard for Installation of Commercial Carpet"* requirements that apply to each in-service condition indicated.

C. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing carpet for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing carpet for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading carpet installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas. Furnish adequate dunnage and bracing during storage.

1. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
2. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.

C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that prevents damage.

1. Avoid damage to packaging and containers, and contamination of contents.
2. Rotate inventory; do not use items the shelf life of which is expired.

D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective carpeting with undamaged new carpeting that do not exhibit deterioration, damage, or defects.

E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install carpet only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Surface Conditions: Surfaces receiving carpet must be dry. Install carpet only when substrate moisture content, vapor emission rate, and surface temperature fall within ranges required, recommended, or accepted by the manufacturer..
 - 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 - 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same type, illumination level, and color temperature maintained in the room or space after the building is occupied.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
 2. Extender Producer Responsibility Program:
 - a. For products in this section from manufacturer that participates in or is directly responsible for an extended producer responsibility program, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Bently Mills.
 - 2. Interface, Inc.
 - 3. Shaw Contract.

2.3 COMMERCIAL TILE CARPETING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 SURFACE PREPARATION

- A. Trowelable Patch and Fill Materials: Specified in Section 03 54 16, unless other products are supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Moisture Vapor Transmission Reduction Coating: Specified in Section 03 35 10 (preventative) or Section 09 05 16 (remedial), unless another coating is supplied, required, recommended, accepted by the by manufacturer for actual in-service conditions applicable to the project.
- C. Substrate Testing and Surface Preparation: Perform testing and corrective work and prepare substrates in conformance with the requirements of Section 09 05 16.

2.5 INSTALLATION MATERIALS

- A. Primer: Water-based, low- or zero-VOC, solvent-free primer supplied, required, recommended, or accepted by the manufacturer for in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
- B. Adhesive:
 - 1. Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of carpet installation; and for adequate bonding of carpet to substrates for all in-service installation conditions, including temperature, relative humidity, and substrate porosity; and expected foot traffic, rolling traffic, and fire-resistance ratings.
 - 2. Wet-tack, percent solids, open-time, stripability, and ease of application must be explicitly formulated for each carpet type and application.

2.6 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify subfloor surfaces are properly secured, smooth, and flat to minimum floor flatness and levelness tolerances required, recommended, or accepted by the manufacturer for the actual in-service conditions applicable to the project.
 - 3. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with [flooring] adhesion, appearance, or performance.
 - 4. Verify items penetrating [flooring] are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and carpet installation. Control and collect dust produced by grinding operations.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Remove substrate coatings and other substances that are incompatible with adhesives or that may negatively affect the quality of the installation, durability, appearance, or performance of either the furnished resilient flooring or adhesives.

2. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with patch and fill materials. Apply, trowel, and float patch material to achieve smooth, flat, hard surface. Prohibit traffic until patch material is cured.
 3. Test substrates for alkalinity (pH), MVER, and relative humidity (RH) and perform corrective work, and substrate preparation as specified in Section 09 05 16 and required by the manufacturer.
 4. Vacuum-clean substrate.
- C. Bond Test: Perform and document bond tests as required, recommended, or accepted by the manufacturer, must be performed and documented before beginning installation.

3.3 INSTALLATION

A. General Requirements:

1. Install carpet using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install carpet under conditions that ensure finishes are free from blemishes and defects.
3. Completed work must match approved samples and mockups, as accepted by the Architect.
4. Installed carpet must be warrantable. Do not install, correct, or replace carpet in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Scribe, cut, and fit carpet to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
2. Extend carpet into toe spaces, door reveals, closets, and similar openings. Extend carpet to centerline of doors in the closed position.
3. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on substrates. Use pencil, chalk, or other nonpermanent, non-staining marking device. The use of markers is prohibited.
4. Adhere carpet 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.

- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere carpet to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, and soiling from all visible carpet surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed flooring in place from soiling, deterioration, and damage until Substantial Completion. Poly-Tak Surface-Shields, Carpet Mask, and similar masking systems are prohibited.
- B. Do not store anything on, adjacent to, or against installed carpet unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed carpet as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

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SECTION 09 72 10 – CONTRACT WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl-coated fabric wall coverings.
2. Surface preparation.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the wall covering manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:

1. Schedule wall covering deliveries to the project site only after the building is enclosed with a permanent enclosure; “wet work” within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; and storage areas are broom- and vacuum-clean.
2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
3. Install wall coverings only after penetrating items are installed and after overhead finishing operations are complete,
4. After wall covering installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

B. Scheduling:

1. Acclimation: Allow sufficient time in the construction schedule to acclimate wall coverings and installation materials to specified ambient conditions for at least 48 hours before installation begins.
2. Primer Installation: Wall coverings must be applied within 24 hours of primer installation. Re-prime surfaces exposed for more than 24 hours; follow manufacturer's instructions for re-priming.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 2. Samples: Submit at least 8-inch square representative samples of each wall covering color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished wall coverings.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals:
 1. Before Final Completion, deliver to the Owner wall covering cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 2. Furnish at least 2 percent of the total installed for each wall covering type, color, composition, grade, finish, and variety, but not less than one unopened box or container.
- D. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide wall coverings having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.

B. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing wall coverings for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing wall coverings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading wall covering installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

1. Furnish adequate dunnage and bracing during storage.
2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
3. Sheet products must be tightly rolled on a sturdy core designed for that purpose and vertically stored unless otherwise required or recommended by the manufacturer
4. Promptly remove and replace rolled sheet products that are flattened or distorted during shipping, unloading, or storage.
5. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or

other sources of deterioration and damage, including dust and other airborne contaminants.

- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 - 1. Avoid damage to packaging and containers, and contamination of contents.
 - 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective wall covering materials with undamaged new wall covering materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install wall coverings only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Surface Conditions: Surfaces receiving wall coverings must be dry. Install wall coverings only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 - 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 - 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.
- C. Other Conditions: Do not apply wall coverings where dust is generated, or liquids are sprayed.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.

1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:

- a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 VINYL-COATED FABRIC WALL COVERINGS

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.3 INSTALLATION MATERIALS

- A. Sealer/Primer: Water-based, low- or zero-VOC, pigmented sealer/primer supplied, required, recommended, or accepted by the manufacturer to condition substrates for wall covering installation.
- B. Adhesive: Water-based, low- or zero-VOC adhesive supplied, required, recommended, or accepted by the manufacturer for ease of wall covering installation; and for adequate bonding of wall coverings to substrates.
 - 1. Adhesive wet-tack, percent solids, open-time, stripability, and ease of application must be specifically formulated for each wall covering type and application.
 - 2. Wall covering adhesives must contain a biocide designed to inhibit the growth of stain and odor causing bacteria; and mold, mildew, and other fungal growth, both "in-the-can" and in the dried adhesive.

2.4 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:

1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with wall covering adhesion, appearance, or performance.
3. Verify items penetrating wall coverings are installed.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and wall covering installation. Control and collect dust produced by grinding operations.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage; and from detrimental effects caused by surface profiling operations. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

1. Prime newly-installed gypsum board.
2. Check painted surfaces for pigment bleeding and treat areas susceptible to pigment bleeding. Sand gloss, semi-gloss, and eggshell finishes with fine sandpaper.
3. Remove coatings and other substances that are incompatible with adhesives, or that may negatively affect the quality of the installation, durability, appearance, or performance of either furnished wall surfacing or wall surfacing adhesives.

3.3 INSTALLATION

A. General Requirements:

1. Install wall coverings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install wall coverings under conditions that ensure finishes are free from blemishes and defects.

3. Completed work must match approved samples and mockups, as accepted by the Architect.
 4. Installed wall coverings must be warrantable. Do not install, correct, or replace wall coverings in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
1. Unroll wall coverings and allow them to stabilize before cutting and fitting.
 2. Lay out wall coverings as follows:
 - a. Maintain uniform wall covering direction.
 - b. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in wall covering substrates.
 - c. Match edges of wall coverings for color shading at seams.
 - d. Avoid cross seams.
 3. Scribe and cut wall coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
 4. Adhere wall coverings 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.
 5. Install seams vertical and plumb, with no horizontal seams.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely adhere wall covering to supporting construction.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed wall coverings in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed wall coverings unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed wall coverings as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 81 33 – ACOUSTICAL INSULATION, SEALANTS, AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concealed acoustical insulation.
2. Acoustical sealants.
3. Acoustical spray.
4. Firestop and acoustical putty pads.
5. Installation materials.
6. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the acoustical insulation or accessory manufacturer, as the context admits, manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. CPVC Coordination: Not all CPVC products are identical. Different CPVC products from different manufacturers may vary in molecular weight, chlorine content and compound additives.

1. Verify selected CPVC product compatibility with all products that may come into contact with selected CPVC, even if contact is inadvertent.
2. Determine chemical composition of CPVC materials and compatibility of selected paints and sealants with selected CPVC materials.
3. Only apply ancillary products that are specifically approved for use on the specific brand of CPVC selected for the project.
4. If an ancillary product is not on a compatibility list, contact the CPVC manufacturer before use. Never assume the absence of a prohibition indicates suitability.
5. Natural oil (vegetable oil or animal fat) and synthetic ester oils, or items containing natural or synthetic oil are prohibited from contacting CPVC.

6. Plasticizers found in certain materials, including incompatible sealants, are prohibited from contacting CPVC.
7. Surfactants found in certain materials, including soaps and detergents, are prohibited from contacting CPVC.
8. Fungicides sprayed on surrounding drywall and wood framing to prevent growth of mold and mildew, are prohibited from contacting CPVC.
9. Scented products, including cologne, perfume, or essential oils (e.g., peppermint oil, orange oil, spearmint oil, etc.), are prohibited from contacting CPVC. (Sometimes used for the purpose of being able to detect leaks by odor)
10. Jacketing on signal-carrying wiring systems often contains plasticizers that are prohibited from contacting CPVC.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Submit manufacturer-prepared published instructions for proper installation of furnished insulation.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.

- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items as shipped, upright in their original containers, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
- C. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.6 PROJECT CONDITIONS

- A. Existing Conditions: Surfaces receiving acoustical insulation must be dry.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.

3. Preference is given to product-specific type III EPDs with LCAs that demonstrate reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. Insulation to be manufactured with 100 percent acrylic binders and no formaldehyde.

2.2 CONCEALED ACOUSTICAL INSULATION

- A. Acoustical Blanket Insulation:

1. Description: Unfaced inorganic glass-fiber blanket acoustical insulation conforming to ASTM C 665 Type I acoustical insulation (blankets without membrane coverings).
2. Manufacturers: Provide one of the following, or equal.
 - a. "CertaPro AcoustaTherm" manufactured by CertainTeed Corp.
 - b. "Sound Control Batts" manufactured by Johns Manville.
 - c. "Sound Attenuation Batts/MW" manufactured by Owens Corning Fiberglass Corp.

B. Sound Attenuating Fire Blanket Insulation:

1. Description: Asbestos-free mineral fiber blanket acoustical insulation conforming to ASTM C 665 requirements for Type I acoustical insulation (blankets without membrane coverings), manufactured from slag and naturally occurring rock.
2. Products: Provide one of the following, or equal.
 - a. "FIBREX Sound Attenuation Fire Batt Acoustical insulation (SAFB)" manufactured by Fibrex Insulations Inc.
 - b. "Thermafiber Sound Attenuating Fire Blankets (SAFB)" manufactured by Owens Corning.
 - c. "ROCKWOOL AFB" manufactured by Roxul Inc.

2.3 ACOUSTICAL SEALANTS

A. Latex Sealants:

1. Description: Non-sag, paintable, non-staining siliconized acrylic-latex sealant conforming to ASTM C 834 requirements for Type OP (opaque sealant), Grade NF (does not meet the requirements for low temperature flexibility of Grade 0°C classification). Verify material compatibility with adjacent materials such as chlorinated polyvinyl chloride (CPVC) pipe.
2. Application: Used where indicated at exposed and concealed joints and annular spaces around through-penetrations.
3. Products: Unless another type is required, recommended, or accepted by the CPVC item manufacturer, provide one of the following, or equal.
 - a. "CP 506 Smoke and Acoustic Sealant" manufactured by Hilti, Inc.
 - b. "QuietZone Acoustic Sealant" manufactured by Owens Corning.
 - c. "AC-20 FTR" manufactured by Pecora Corp.
 - d. "Tremflex 834" manufactured by Tremco, Inc.
 - e. "Sheetrock Acoustical Sealant" manufactured by USG Corp.
4. Requisite Properties:
 - a. Color: White.

B. Non-Drying, Non-Hardening, Non-Skinning Sealants:

1. Description: Single-component butyl rubber sound dampening elastomeric sealant conforming to ASTM Standard D 217. Verify material compatibility with adjacent materials such as chlorinated polyvinyl chloride (CPVC) pipe.
2. Application: Installed at concealed joints where indicated.

3. Products: Unless another type is required, recommended, or accepted by the CPVC item manufacturer, provide one of the following, or equal.
 - a. "BA-98" manufactured by Pecora Corp.
 - b. "QuietSeal Acoustical Sealant QS-350" manufactured by Serious Materials, Inc.
 - c. "Acoustical Sealant" manufactured by Tremco, Inc.
- C. Fire Rated, Non-Hardening,, Sealant:
 1. Description: Verify material compatibility with adjacent materials such as chlorinated polyvinyl chloride (CPVC) pipe.
 2. Products: Unless another type is required, recommended, or accepted by the CPVC item manufacturer, provide one of the following, or equal.
 - a. "Fire Barrier 2001 Silicone RTV Foam" manufactured by 3M.
 - b. "CP 601S Elastomeric Firestop Sealant" manufactured by HILTI.
 - c. "Firetemp CI Caulk" manufactured by Johns Manville.
 - d. "Spec Seal ES100" manufactured by Specified Technologies, Inc.
- D. Expanding Foam Sealant:
 1. Description: Gun-applied, expanding spray foam sealant. Verify material compatibility with adjacent materials such as chlorinated polyvinyl chloride (CPVC) pipe
 2. Application: Used to seal and insulate around common areas of energy loss, including foundation/sill plates, outdoor fixtures, pipe penetrations, etc.
 3. Products: Unless another type is required, recommended, or accepted by the CPVC item manufacturer, provide one of the following, or equal.
 - a. "GREAT STUFF PRO Gaps & Cracks" manufactured by The Dow Chemical Co.
 - b. "Polycell" manufactured by M-D Building Products, Inc.
 - c. "Expanding Foam Polyfilla" manufactured by Polyfilla.
- E. Cementitious Sealant: "Monokote Z-146" manufactured by GCP Applied Technologies, Inc., or equal.
- F. Preformed Tape Sealants:
 1. Fire-Resistance Rated Conditions:
 - a. Description: Compressible, self-extinguishing, UL-listed closed cell polyvinyl chloride foam tape with pressure sensitive adhesive.
 - b. Application: Installed at concealed joints in fire-resistance rated construction, where indicated.
 - c. Product: "Norseal V740FR" manufactured by Norton Performance Plastics Corp., or equal.
 - d. Requisite Properties:
 - 1) Size: One-inch minimum roll width, unless another width is indicated on the Drawings.
 - 2) Thickness: At least 1/8-inch, unless another thickness is indicated on the Drawings.

- 3) Density: At least 9 pounds per cubic foot.
 - 4) Facing: Furnish tape in rolls with protective release liner on non-adhesive face.
2. Elsewhere:
- a. Description: Compressible, closed cell polyvinyl chloride foam tape with pressure sensitive adhesive.
 - b. Application: Installed at concealed joints, where indicated.
 - c. Product: "Norseal V730" manufactured by Norton Performance Plastics Corp., or equal.
 - d. Requisite Properties:
 - 1) Size: One-inch minimum roll width.
 - 2) Thickness: At least 3/8-inch.
 - 3) Density: At least 6 pounds per cubic foot.
 - 4) Facing: Furnish tape in rolls with protective release liner on non-adhesive face.

2.4 ACOUSTICAL SPRAY

- A. Description: Sprayable acrylic latex material.
- B. Application: Used where indicated at exposed and concealed static or minimally dynamic joints or gaps in wall construction.
- C. Products: Provide one of the following, or equal.
1. "CP 572 Smoke and Acoustic Spray" or "CFS-SP WB Firestop Joint Spray" manufactured by Hilti, Inc.
 2. "Spec Seal Smoke 'N' Sound Sealant" manufactured by Specified Technologies, Inc.
 3. "TREMstop Smoke & Sound Sealant" or "TREMstop Acrylic" manufactured by Tremco, Inc.
- D. Requisite Properties:
1. Spray must be mold and mildew resistant in conformance with ASTM G21.
 2. Spray must have a minimum movement capability of at least 12.5 percent.

2.5 FIRESTOP AND ACOUSTICAL PUTTY PADS

- A. Description: Sound deadening pads.
- B. Application: Used to seal the external surfaces (back side) of metallic and nonmetallic switch and receptacle boxes to reduce airborne sound transmission in interior partitions.
- C. Fire-Resistance Rated Construction (Firestop Putty Pads): Provide one of the following, or equal.
1. "CP 617 Firestop Putty Pads" manufactured by Hilti, Inc.

2. "Putty Pads" manufactured by International Protective Coatings
 3. "Type FSP Firestop Putty" pads by Nelson Electric.
 4. "Putty Pads" manufactured by Specified Technologies, Inc.
 5. "TREMstop MP" manufactured by Tremco, Inc.
- D. Elsewhere (Acoustical Putty Pads): Provide one of the following, or equal.
1. "Lowry Box Pads" manufactured by Henry A. Lowry Co.
 2. "Sound Pad #68" manufactured by LH Dottie Co.

2.6 INSTALLATION MATERIALS

- A. Acoustical Insulation Hangers:
1. Application: Used to attach acoustical insulation to clean, dry, smooth, non-porous solid surfaces.
 2. Manufacturer: Provide products manufactured by AGM Industries, Inc., or equal.
 3. Products: Provide the following, or equal.
 - a. Anchors: "TACTOO Insul-Hangers" adhesively attached spindle-type anchors.
 - b. Adhesive: "BOSS 348 Multi-Purpose Construction Adhesive" manufactured by Accumetric, LLC or other VOC-compliant acoustical insulation hanger adhesive.
 - c. Acoustical insulation Standoff: One-inch "Clutch Clip".
 - d. Acoustical insulation Retaining Washers: "Style RC 200" round or "SC 250" square washers.
 4. Requisite Properties:
 - a. Base Plate and Acoustical insulation Standoff and Retaining Washers: At least 2-inch square by at least 0.149-inch (MSG 28) base metal thickness galvanized perforated steel sheet.
 - b. Retaining Washers: At least 1-1/2-inch square or diameter by at least 0.149-inch (MSG 28) base metal thickness galvanized perforated steel sheet.
 - c. Spindle: At least 0.106-inch diameter (SWG 12), zinc-coated wire, depth to suit depth of acoustical insulation indicated.
 - d. Adhesive: Adhesive used with impaling pins must either be manufactured or accepted by the acoustical insulation hanger manufacturer. "Peel and press" hangers with self-adhering adhesive backings are prohibited.
- B. Mechanical Fasteners: Tape, staples, and other devices for fastening acoustical insulation supplied, required, recommended, or accepted by the acoustical insulation manufacturer.
- C. Hanger Wire: At least 0.106-inch diameter (SWG 12) soft temper zinc-coated wire conforming to ASTM A 641, Class 3 or A coating.
- D. Adhesive: Supplied, require, recommended, or accepted by the acoustical insulation manufacturer to bond acoustical insulation securely to substrates indicated without damaging acoustical insulation or substrates.

2.7 ACCESSORIES

A. Joint Backing:

1. Description: Extruded closed-cell polyethylene foam cylindrical sealant backings conforming to ASTM C 1330, Type C.
2. Products: Provide one of the following, or equal.
 - a. "Mile High Foam" manufactured by Backer Rod Mfg. Inc.
 - b. "HBR" or "Green Rod" manufactured by Nomaco, Inc.
 - c. "NuFlex 870" manufactured by TVM Building Products.
3. Performance Requirements:
 - a. Maximum Water Absorption: Not more than 0.10 grams per cubic centiliter when tested in conformance with conformance with ASTM C 1016, Procedure B.
 - b. Minimum Density: At least 24 per cubic meter when tested in conformance with conformance with ASTM D 1622.
 - c. Maximum Outgassing: Less than 1 bubble when tested in conformance with conformance with ASTM D 1253.
 - d. Minimum Compression Recovery: At least 90 percent, when tested in conformance with conformance with ASTM D 5249.
 - e. Minimum Compression Deflection: At least 20.5 percent, when tested in conformance with conformance with ASTM D 5249.
 - f. Minimum Tensile Strength: At least 200 kPa, when tested in conformance with conformance with ASTM D 1623.

- ### B. Accessories:
- Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- ### A. Oversight:
- Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- ### B. Verification:
- Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- ### C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.

2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install acoustical insulation using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Extend acoustical insulation to envelop entire area insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
3. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of acoustical insulation to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
4. Installed acoustical insulation must be warrantable. Do not install, correct, or replace acoustical insulation in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Wall Insulation:
 - a. Install acoustical insulation in cavities formed by framing members.
 - b. Use acoustical insulation that fills the cavities. If more than one length is required to fill the cavities, then provide lengths that will produce a snug fit between ends.
 - c. Place acoustical insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - d. Maintain 3-inch clearance around recessed lighting fixtures not rated for or protected from contact with acoustical insulation.
 - e. Stuff loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to roughly 40 percent of normal maximum volume.
 - f. For metal-framed wall cavities higher than 96 inches, support unfaced blankets mechanically and support faced blankets by taping insulation flanges to metal stud flanges.
2. Ceiling Insulation:
 - a. Install blanket acoustical insulation above ceilings where indicated.
 - b. Maintain 3-inch clearance of acoustical insulation around recessed lighting fixtures.
3. Acoustical Sealant Installation:
 - a. At sound-rated assemblies and elsewhere indicated, seal construction in conformance with ASTM C 919 with a continuous bead of acoustical sealant at perimeter, behind control joints, and at openings and penetrations.
 - b. Install acoustical sealant to both faces of partitions at perimeters and through penetrations.

C. Acoustical Installation Requirements:

1. Application: Apply acoustical sealant where shown on drawings and the following.
 - a. Both sides and perimeter of door and window frames.
 - b. Penetrations of partitions, floors, and ceilings by piping, ventilation ducts, conduits, cables, and cable trays.
 - c. Perimeter and between joints of all sound isolating partitions, floors, and ceilings.
 2. Acoustical Sealant:
 - a. Use continuous beads of acoustical sealant along gypsum board face layer to seal assemblies at head, sill, perimeter, and penetrations, and joints between layers of sound isolating gypsum board construction and around the perimeter of resilient ceilings.
 - b. Comply with ASTM C 919 requirements for use of joint sealants in acoustical applications as applicable to materials and conditions indicated.
 3. Sheet Sealant:
 - a. In full height, sound rated, and sound sensitive walls, over back and sides of all electrical, telephone, and communication boxes with specified acoustical pads.
 - b. Verify unused knockouts are plugged before installing the pads. Mold pads tightly to the boxes and to the adjacent surfaces.
 4. Installation:
 - a. To seal gaps 3/8-inch in dimension and larger, pack with glass/mineral fiber batt prior to installing sealant materials.
 - b. Use compressible closed-cell foam backer rod as required. Uncompressed backer rod width should be 30 to 50 percent greater than joint width.
- D. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach acoustical insulation to supporting construction.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed acoustical insulation in place from becoming wet, deterioration, and damage until covering.
- B. Do not store anything adjacent to or against installed acoustical insulation unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed acoustical insulation as work surfaces.
- C. Remove protection when it's no longer needed and before covering.

END OF SECTION

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SECTION 09 84 15 – ACOUSTICAL CEILING BAFFLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Suspended acoustic baffles.
2. Supporting framework.
3. Installation materials.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the ceiling baffle manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate ceiling layout and installation with adjacent construction elements that penetrate ceilings, or is supported by them, including

1. light fixtures;
2. HVAC equipment;
3. fire-suppression system components;
4. partition assemblies; and
5. perimeter conditions.

B. Sequencing:

1. Schedule ceiling baffle deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; and storage areas are broom- and vacuum-clean.
2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination,

- and color temperature, maintained in the room or space after the building is occupied.
 - 3. Install ceiling baffles only after penetrating items are installed.
 - 4. After ceiling baffle installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.
- C. Scheduling: Allow sufficient time in the construction schedule to acclimate ceiling baffles to specified ambient conditions for at least 48 hours before installation begins.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
- 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing ceiling baffle layout, materials, joints, edge conditions, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans.
 - 3. Samples: Submit at least 8-inch square representative samples of each ceiling baffle variety for each specified color and finish.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
- 1. Coordination Drawings: Submit at least 1/4-inch scale dimensioned reflected ceiling plans showing the following items coordinated with each other, based on input from installers of each item involved.
 - a. Ceiling suspension system members.
 - b. Method of attaching hangers to building structure. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 - c. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 2. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished acoustical ceilings.

- a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
- b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
3. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Maintenance Material Submittals:

1. Before Final Completion, deliver to the Owner extra stock materials to replace those worn or damaged as a result of normal occupancy.
2. Furnish at least 2 percent of the total installed for each ceiling baffle type, color, composition, grade, finish, and variety, but not less than one box or open container.

D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Ceiling baffles must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide ceiling baffles having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.

C. Quality Standards

1. Seismic Standard: Provide ceiling baffles designed and installed to withstand the effects of earthquake motions in conformance with ASCE/SEI 7, "*Minimum Design Loads For Buildings and Other Structures*"; CISC publication, "*Seismic Construction Handbook*"; and California Building Code Sections 803.9.1.1, 1614, and 2506.2.1.
2. Installation Standard: Comply with CISC publication "*Ceiling Systems Handbook*" requirements for installation.

D. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing ceiling baffles for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing ceiling baffles for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading ceiling baffle installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.

- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective ceiling materials with undamaged new ceiling materials that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install ceiling baffles only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 ACOUSTICAL CEILING BAFFLES

- A. Product: "SoftGrid Trella" manufactured by Arktura LLC, or equal.
- B. Requisite Properties:
 - 1. Size: Indicated on the Drawings.
 - 2. Color: "Cream", or equal.
- C. Minimum Noise Reduction Coefficient (NRC): At least NRC 0.70, when tested in conformance with ASTM E 492 and ASTM E 989.

2.3 SUSPENSION SYSTEMS

- A. Description: Non-rated direct hung ceiling suspension system conforming to ASTM C 635 requirements for Heavy Duty structural classification.

- B. Products: Provide the following manufactured by Arktura LLC, or equal.
 - 1. Threaded Rods: Required, recommended, or accepted by the manufacturer.
 - 2. Hanger Ribs: Supplied by the manufacturer.
 - 3. Fin Support Ribs: Supplied by the manufacturer.

2.4 ACCESSORIES

- A. Attachment Devices: Sized for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify items penetrating ceiling baffles are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:

1. Install ceiling baffles using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed ceiling baffles must be warrantable. Do not install, correct, or replace ceiling baffles in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach ceiling baffles to supporting construction.
- C. Installation Tolerances: Ceilings must conform to the following tolerances, which are non-cumulative.
1. Maximum Out of Plane: Surfaces may not vary by more than 1/8-inch in 10 feet.
 2. Carrying Channel Maximum Out of Level: Not more than 1/8-inch in 12 feet,
 3. Main Runner Maximum Out of Level: Not more than 1/4-inch in 10 feet,
 4. Main Runner Maximum Deflection: Not more than L/360 of span,
 5. Maximum Misalignment of Main Runners: 0.015-inch.
 6. Maximum Misalignment of Intersection Members: 0.020-inch.
 7. Main Runner Bow, Camber, and Twist: Not more than 1/32-inch in 2 feet bow or camber; not more than one degree twist.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible surfaces in a manner that does not result any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed ceiling baffles in place from deterioration, and damage until Substantial Completion.
- B. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 84 33 – SOUND-ABSORBING WALL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sound-absorbing wall units.
 - 2. Fabric facings.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the wall unit manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing:
 - 1. Schedule wall unit deliveries to the project site only after the building is enclosed with a permanent enclosure; “wet work” within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; and storage areas are broom- and vacuum-clean.
 - 2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
 - 3. Install wall units only after penetrating items are installed and after overhead finishing operations are complete.
 - 4. After installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.
- B. Scheduling: Allow sufficient time in the construction schedule to acclimate wall units to specified ambient conditions for at least 48 hours before installation begins.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned elevations drawn to scale and showing wall units layout, materials, joints, edge conditions, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to elevations.
 - 3. Samples: Submit at least 8-inch square representative samples of each wall units variety for each specified color and finish.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished fabric wrapped panels.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 - 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals:
 - 1. Before Final Completion, deliver to the Owner wall units cleaning materials, equipment, accessories, and instructions; and extra stock materials to replace those worn or damaged as a result of normal occupancy.
 - 2. Furnish at least 2 percent of the total installed for each wall units type, color, composition, grade, finish, and variety, but not less than 3 fabric wrapped panels.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Wall units must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide wall units having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.

C. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing wall units for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing wall units for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading wall unit installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 - 1. Furnish adequate dunnage and bracing during storage.
 - 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.
 - 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective wall units with undamaged new wall units that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install wall units only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 - 1. Substrate Dimensional Tolerances: Surfaces receiving wall units must be flat with 1/4-inch within any 10-foot radius.
 - 2. Deflection: Maximum deflection of substrate system under positive or negative design loads must not exceed $L/360$ of span.
 - 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 - 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Lamvin Inc
 - 2. Acoustical Solutions.
 - 3. Armstrong World Industries.

2.3 SOUND-ABSORBING WALL UNITS

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 FABRIC FACING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.5 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
 - 2. Verify items penetrating wall units are installed.
- C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Set wall units true to line, to required levels and lines, plumb, square, and cut and fitted without warp or rack; sloped or level as required; with flush well-fitted joints; and in alignment with adjacent construction.
2. Fit exposed connections accurately to form flush hairline joints

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach wall units to supporting construction.

C. Installation Tolerances: Install wall units to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed wall units in place from deterioration, and damage until Substantial Completion.
- B. Do not store anything adjacent to or against installed wall units unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed wall units as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 09 91 00 – PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field-applied finish paint.
2. Surface preparation.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 97 13 for high performance steel coatings applied to steel surfaces installed in SSPC Environmental Zones 1B, 2A, and 2B.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. DFT: Dry Film Thickness.
2. GU: Gloss Unit.
3. SSPC: The Society for Protective Coatings.

B. Definitions:

1. Manufacturer: Means the paint manufacturer, unless otherwise indicated.
2. Paint: Means all applied materials, including fillers, primers, emulsions, enamels, varnishes, stains, lacquers, and sealers, whether used as a prime, intermediate, or finish coat.
3. Coating: Means the same as paint.
4. Coat: Means a layer of paint that is applied and then permitted to dry. Both back-rolling and applying wet-on-wet are one coat.
5. Finish: Means an entire coating system, including all surface preparation methods, primers, coats, textures, colors, and sheens.
6. Thickness: Means the total finish DFT, measured in conformance with SSPC paint application standard SSPC-PA2, *"Measurement of Dry Coating Thickness with Magnetic Gages"*.
7. Touchup: Means to correct or repair non-conforming or deficient areas to bring into conformance with the Contract Documents.
8. Refinish: Means to apply a new finish to a previously-finished item or surface.

9. Sheen: Means the following gloss ranges, when tested in conformance with ASTM D 523.

Sheen	Reference Description	Gloss Range	Test Method
Gloss Level 1 (Low Sheen)	Matte/Flat	1 to 5 GU 1 to 10 GU	60-degree meter 85-degree meter
Gloss Level 2 (Low Sheen)	Velvet	6 to 10 GU 11 to 24 GU	60-degree meter 85-degree meter
Gloss Level 3 (Medium Sheen)	Eggshell	11 to 20 GU 25 to 35 GU	60-degree meter 85-degree meter
Gloss Level 4 (Medium Sheen)	Satin	21 to 35 GU >35 GU	60-degree meter 85-degree meter
Gloss Level 5 (Medium Sheen)	Low sheen	36 to 49 GU	60-degree meter
Gloss Level 6 (Medium Sheen)	Semi-gloss	50 to 70 GU	60-degree meter
Gloss Level 7 (High Sheen)	Gloss	71 to 85 GU Up to 60 GU	60-degree meter 20-degree meter
Gloss Level 8 (High Sheen)	High-Gloss	>85 GU >60 GU	60-degree meter 20-degree meter

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Unless otherwise indicated, paint all surfaces throughout the Project, except the following.
 - a. Concrete.
 - b. Steel decking.
 - c. Roofing.
 - d. Insulation and its facing.
 - e. Finish hardware, except items specified with a USP finish.
 - f. Prefinished metal surfaces, including anodized aluminum, chrome plating, powder coatings, and similar pre-finished materials.
 - g. Natural finish metal surfaces, including mill finish aluminum, stainless steel, copper, bronze, brass and similar finished materials.
 - h. Walls or ceilings in concealed and inaccessible areas, including furred areas, chases, and shafts.

- i. Moving, mechanical, or electrical parts of operating units, including valve and damper operator linkages, sensing devices, motor and fan shafts..
 - j. Nameplates and required labels, including UL, FM, and other equipment identification, performance rating, or name plates.
2. Paint all visible surfaces, including surfaces visible through registers, screens and grilles whether or not colors are designated, except where a material's natural finish is obviously intended or explicitly indicated as a surface not painted.
3. Where surfaces are not specifically indicated, paint them to match adjacent similar materials or areas.
4. Specified surface preparation, priming, and paint coats are in addition to surface preparation and shop priming indicated in other specification sections.
5. Coordinate selected paint for compatibility with primers indicated in other specification sections.
 - a. Provide prime coats that are compatible with subsequent coats or provide compatible barrier coats over incompatible primers; or completely remove primer and re-prime.
 - b. Verify chemical and adhesive compatibility of all coats within each paint finish.
6. Coordinate selected paint for compatibility with chemicals used near or on painted surfaces, including cleaning materials, accessories, and methods.
7. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified paint are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
8. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.
9. Master Painters Institute standards are insufficient for and not applicable to this project.

B. Sequencing:

1. Schedule paint deliveries to the project site only after the building is enclosed with a permanent enclosure; "wet work" within storage areas (including concrete, cast underlayment, mortaring, grouting, plastering, and gypsum board finishing) is complete and cured or dried to a condition of equilibrium; storage areas are broom- and vacuum-clean; and the HVAC system is activated, operating, and maintaining ambient conditions at occupancy levels.
2. Before beginning installation, final light fixtures must be completely installed, energized, and fully illuminated to at least the same type and level of illumination, and color temperature, maintained in the room or space after the building is occupied.
3. Install paint only after penetrating items are installed.

4. After paint installation, maintain ambient conditions within a range required, recommended, approved, or accepted by the manufacturer until Final Completion.

C. Scheduling:

1. Concrete Curing: Allow enough time in the construction schedule for concrete to cure for at least 28 days and dry before beginning surface preparation and installation.
2. Concrete Masonry Units: CMU walls must be painted within 30 days after building close-in.
3. Cleaning: Schedule cleaning to prevent dust and other contaminants from falling on freshly-applied paint.

1.4 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Paint Schedule:
 - a. Prepare a list of specified finishes and their project locations, with selected products identified for each coat of every finish.
 - b. Identify substrates to which each specified finish is applied, including surface preparation methods and primers for each substrate.
3. Samples: Submit 8-1/2-inch by 11-inch drawdown cards of each specified color and sheen. Label each card with project location.

B. Maintenance Material Submittals:

1. Before Final Completion, deliver to the Owner extra stock materials to replace those worn or damaged as a result of normal occupancy.
2. Furnish one unopened gallon or container for each paint type, color, composition, grade, finish, and variety.
3. Submit manufacturer-recommended cleaning materials, accessories, and manufacturer's instructions and other requirements and recommendations for maintenance and cleaning of painted surfaces, including a comprehensive list of known chemicals that should not come into contact with painted surfaces.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Source Limitations:

1. Paint must be obtained through one source from the same manufacturer (to ensure compatibility and a uniform appearance).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Field Samples: Include *in-situ* mockups as part of the work of this specification section.

1. The Architect reviews field samples for conformance to the Contract Documents and approves or rejects them as the standard by which subsequent work is evaluated.
2. Revise field samples and repeat reviews, including arranging all revisions and paying all revision costs, until accepted in writing by the Architect. Final acceptance of paint is made from field samples.
3. After acceptance, promptly identify and protect field samples for reference until Substantial Completion.
4. Approved field samples may remain part of the work after being identified for future reference.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

1. Furnish adequate dunnage and bracing during storage.

2. Prevent stored items from contacting the floor and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install paint only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
1. Surface Conditions: Surfaces receiving paint must be dry. Install paint only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Ventilation: Maintain adequate ventilation during and after installation and curing, setting, or drying. Where natural ventilation is inadequate, use forced-air circulation or mechanical ventilation as necessary for the installations indicated.
 3. Illumination: Provide permanent lighting or illuminate work spaces to at least the same level occurring in the room or space after Final Completion.
- C. Other Conditions: Do not apply paint where dust is generated, or liquids are sprayed; or when windy conditions exist that may cause paint to be blown onto vegetation or other unintended surfaces.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Dunn Edwards.
 - 2. Sherwin Williams
 - 3. Benjamin Moore.

2.3 PAINT

- A. Description: 100-percent premium grade (best grade) low- and no-VOC paints, unless otherwise indicated.
- B. Products: Indicated in the Paint Products Schedule at the end of this specification section.
- C. Requisite Properties:
 - 1. Colors: Indicated on the Drawings in the Finish Legend, Sheet A6.30.
 - 2. Sheens: Provide the following, unless otherwise indicated.
 - a. Ceilings: Not more than Gloss Level 3. (Eggshell)
 - b. Trim: At least Gloss Level 6. (Gloss)
 - c. Bathroom Walls: At least Gloss Level 5. (Semi-Gloss)
 - d. Other Walls: At least Gloss Level 3. (Eggshell)

2.4 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 MIXING

- A. Factory-mix paint to match approved samples and mockups accepted by the Architect.
- B. Box paint at the project site or factory-batch to ensure uniform and consistent color. This requirement includes specified maintenance materials.
- C. Open paint containers only as required for use and mix only in designated areas.
- D. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- E. Do not reduce, alter, or introduce foreign materials into paint, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with paint adhesion, appearance, or performance.
 - 3. Verify items penetrating paint are installed.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and paint installation.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
 - 3. Opening Protection: Close and protect drains and other openings and penetrations to prevent paint intrusion or migration of liquids.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install paint using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Only install paint under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. Painted surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed paint must be warrantable. Do not install, correct, or replace paint in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Produce uniform finished surfaces without substrates, undercoats, marks, or stains showing through. Produce sharp and even lines and color breaks.
2. Paint surfaces behind movable equipment and furniture the same as adjacent exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint back sides of access panels, removable or hinged covers, and similar hinged items the same as exposed surfaces.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.

2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.

- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed paint in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against painted surfaces unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use painted surfaces as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

3.7 SCHEDULE

- A. Paint products schedule begins on the next page.

END OF SECTION

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SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
EXTERIOR SURFACES - LOW VOC				
Concrete & CMU Substrates: As specified in Section 09 96 53 - Elastomeric Coatings				
Concrete & Brick Substrates: 100% Acrylic FLAT				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop	023 Fresh Start Primer
	2 nd Coat	2000 Duratone	EVSH10 Evershield Flat	400 Regal Select Flat
	3 rd Coat	2000 Duratone	EVSH10 Evershield Flat	400 Regal Select Flat
CMU Substrates: 100% Acrylic FLAT				
	1 st Coat	018 Acrylic Block Filler	SBPR00 Blockfill	M88 Latex Block Filler
	2 nd Coat	2000 Duratone	EVSH10 Evershield Flat	400 Regal Select Flat
	3 rd Coat	2000 Duratone	EVSH10 Evershield Flat	400 Regal Select Flat
CMU Substrates: 100% Acrylic ELASTOMERIC				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop	023 Fresh Start Primer
	2 nd Coat	500 Solotex	W370 Endurawall	056 Moorlastic
	3 rd Coat	500 Solotex	W370 Endurawall	056 Moorlastic
Finished Wood Surfaces: 100% Acrylic FLAT				
	1 st Coat	4200 Terminator II	EZPR00 EZ Prime Premium	0046 Hi-Hide All Purpose Primer
	2 nd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
	3 rd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
Finished Wood Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4200 Terminator II	EZPR00 EZ Prime Premium	0046 Hi-Hide All Purpose Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096Regal Soft Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096Regal Soft Gloss
Finished Wood Surfaces: 100% Acrylic GLOSS				
	1 st Coat	4200 Terminator II	EZPR00 EZ Prime Premium	0046 Hi-Hide All Purpose Primer
	2 nd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	NA
	3 rd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	NA

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Finished Wood Surfaces: Semi-Transparent Stain				
	1 st Coat	Olympic Maximum ST Stain	Okon WPT-3	0638 Arborcoat S/T Stain
	2 nd Coat	Olympic Maximum ST Stain	Okon WPT-3	0638 Arborcoat S/T Stain
Iron, Steel, and Galvanized Steel Surfaces: Specified in Section 09 97 13 - High Performance Steel Coatings				
Iron & Steel Substrates: 100% Acrylic GLOSS				
	1 st Coat	9600 Protec	BRPR00-1 Block Rust	M04 Acrylic Metal Primer
	2 nd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	N/A
	3 rd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	N/A
Iron & Steel Substrates: 100% Acrylic SEMI-GLOSS				
	1 st Coat	9600 Protec	BRPR00-1 Block Rust	M04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	402 Regal Soft Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	402 Regal Soft Gloss
Galvanized Steel & Aluminum Substrates: 100% Acrylic GLOSS				
	Pretreatment	Krud Kutter Metal Etch	ME01 Etch	Jasco Prep N Prime
	1 st Coat	4800 Metal Pro Primer	GAPR00 Galv-Alum Premium	P04 Acrylic Metal Primer
	2 nd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	N/A
	3 rd Coat	8500 Carefree Gloss	EVSH60 Evershield Gloss	N/A
Galvanized Steel & Aluminum Substrates: 100% Acrylic SEMI-GLOSS				
	Pretreatment	Krud Kutter Metal Etch	ME01 Etch	Jasco Prep N Prime
	1 st Coat	4800 Metal Pro Primer	GAPR00 Galv-Alum Premium	P04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096 Regal Soft Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096 Regal Soft Gloss

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
<u>Zinc Alloy Surfaces:</u> 100% Acrylic SEMI-GLOSS				
	Pretreatment	Krud Kutter Metal Etch	ME01 Etch	Jasco Prep N Prime
	1 st Coat	4800 Metal Pro Primer	GAPR00 Galv-Alum Premium	P04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096 Regal Soft Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	EVSH50 Evershield Semi Gloss	W096 Regal Soft Gloss
<u>Fiber Cement Board Surfaces:</u> 100% Acrylic FLAT				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop	N023 Fresh Start Primer
	2 nd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
	3 rd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
<u>Portland Cement Plaster (Stucco) Surfaces (Does not apply to Polymer-Modified Plaster Surfaces):</u> Specified in Section 09 96 53 - Elastomeric Coatings				
<u>Gypsum Soffit Board Surfaces:</u> 100% Acrylic FLAT				
	1 st Coat	4600 Uniprime II	Inter-Kote Premium IKPR00	N023 Fresh Start Primer
	2 nd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
	3 rd Coat	2000 Duratone	EVSH10 Evershield Flat	W105 Regal Select Flat
<u>I N T E R I O R S U R F A C E S - L O W V O C</u>				
<u>Concrete Surfaces:</u> 100% Acrylic FLAT				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop	N023 Fresh Start Primer
	2 nd Coat	7100 Acriglo Flat	SSHL10 Spartashield Flat	547 Regal Select Flat
	3 rd Coat	7100 Acriglo Flat	SSHL10 Spartashield Flat	547 Regal Select Flat
<u>Concrete Surfaces:</u> 100% Acrylic EGGSHELL				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	7500 Acriglo Eggshell	SSHL30 Spartashield Eggshell	550 Regal Select Pearl
	3 rd Coat	7500 Acriglo Eggshell	SSHL30 Spartashield Eggshell	550 Regal Select Pearl

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Concrete Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
Concrete Surfaces: 100% Acrylic GLOSS				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Concrete Surfaces: 100% Epoxy GLOSS				
	1 st Coat	4600 Uniprime II	Rust Oleum Sierra S70/S71 WB	N023 Fresh Start Primer
	2 nd Coat	Rust-Oleum Sierra S60 Gloss WB Epoxy	Rust-Oleum Sierra S60 Gloss WB Epoxy	P43 Super Spec HP Gloss Epoxy
CMU Surfaces: 100% Acrylic Flat				
	1 st Coat	018 Acrylic Block Filler	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	7100 Acriglo Flat	SSHL10 Spartashield Flat	547 Regal Select Flat
	3 rd Coat	7100 Acriglo Flat	SSHL10 Spartashield Flat	547 Regal Select Flat
CMU Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	018 Acrylic Block Filler	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	7500 Acriglo Eggshell	SSHL30 Spartashield Eggshell	550 Regal Select Pearl
	3 rd Coat	7500 Acriglo Eggshell	SSHL30 Spartashield Eggshell	550 Regal Select Pearl
CMU Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	018 Acrylic Block Filler	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
CMU Surfaces: 100% Acrylic GLOSS				
	1 st Coat	040 Block Kote	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
CMU Surfaces: 100% Epoxy GLOSS				
	1 st Coat	040 Block Kote	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	Rust-Oleum Sierra S60 Gloss WB Epoxy	Rust-Oleum Sierra S60 Gloss WB Epoxy	P43 Super Spec HP Gloss Epoxy
Ferrous Metal Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	9600 Protec	BRPR00 Bloc-Rust	P04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
Ferrous Metal Surfaces: 100% Acrylic GLOSS				
	1 st Coat	9600 Protec	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Aluminum Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	9600 Protec	BRPR00 Bloc-Rust	P04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
Aluminum Surfaces: 100% Acrylic GLOSS				
	1 st Coat	9600 Protec	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Stainless Steel, Copper, and Brass Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	9600 Protec	BRPR00 Bloc-Rust	P04 Acrylic Metal Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SSHL50 Spartashield Semi-Gloss	551 Regal Select Semi Gloss
Stainless Steel, Copper, and Brass Surfaces: 100% Acrylic GLOSS				
	1 st Coat	9600 Protec	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
<u>Rough Sawn Wood Surfaces:</u> Semi-Transparent Stain				
	1 st Coat	Olympic S/T Stain	Okon WPT-3	0638 Arborcoat S/T Stain
	2 nd Coat	Olympic S/T Stain	Okon WPT-3	0638 Arborcoat S/T Stain
<u>Finished Wood Surfaces:</u> Semi-Transparent Stain				
	1 st Coat	VWS0250 Series ST Stain	Old Masters Wood Stain	Moore's S/T WB Stain
<u>Finished Wood Surfaces:</u> Clear Lacquer Finish				
	1 st Coat	NRS 1620 Sanding Sealer	LQX 101-0 Sanding Sealer	NRS 1620 Sanding Sealer
	2 nd Coat	NRF 1626 Satin Lacquer	LQX 104-0 Satin Lacquer	NRF 1626 Satin Lacquer
	3 rd Coat	NRF 1626 Satin Lacquer	LQX 103-0 Satin Lacquer	NRF 1626 Satin Lacquer
<u>Finished Wood Surfaces:</u> Water White Finish (for light-colored stains)				
	1 st Coat	NAF 1420 Satin Sealer	LQX 131-0 Sanding Sealer	NAF 1420 Satin Sealer
	2 nd Coat	NAF 1422 Satin Lacquer	LQX 132-0 Satin Lacquer	NAF 1426 Satin Lacquer
	3 rd Coat	NAF 1422 Satin Lacquer	LQX 132-0 Satin Lacquer	NAF 1426 Satin Lacquer
<u>Finished Wood Surfaces:</u> Clear Varnish Finish FLAT				
	1 st Coat	Zenith PKF7501 Flat	Zenith PKF7501 Flat	Zenith PKF7501 Flat
	2 nd Coat	Zenith PKF7501 Flat	Zenith PKF7501 Flat	Zenith PKF7501 Flat
	3 rd Coat	Zenith PKF7501 Flat	Zenith PKF7501 Flat	Zenith PKF7501 Flat
<u>Finished Wood Surfaces:</u> Clear Varnish Finish SEMI-GLOSS				
	1 st Coat	Zenith PKF7501 Flat	Zenith PKF7502 Satin	Zenith PKF7502 Satin
	2 nd Coat	Zenith PKF7501 Flat	Zenith PKF7502 Satin	Zenith PKF7502 Satin
	3 rd Coat	Zenith PKF7501 Flat	Zenith PKF7502 Satin	Zenith PKF7502 Satin
<u>Finished Wood Surfaces:</u> Clear Varnish Finish GLOSS				
	1 st Coat	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss
	2 nd Coat	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss
	3 rd Coat	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss	Zenith PKC7509 Gloss
<u>Finished Wood Surfaces:</u> 100% Acrylic LOW SHEEN				
	1 st Coat	4200 Terminator II	UGPR00 Ultra-Grip	0046 Hi-Hide All Purpose Primer
	2 nd Coat	1750 Acriglo Low Sheen	SPMA20 Suprema VS	549 Regal Select Eggshell
	3 rd Coat	1750 Acriglo Low Sheen	SPMA20 Suprema VS	549 Regal Select Eggshell

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Finished Wood Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4200 Terminator II	UGPR00 Ultra-Grip	0046 Hi-Hide All Purpose Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
Finished Wood Surfaces: 100% Acrylic Dryfall FLAT				
	1 st Coat	DF 12 Dryfall Flat	W 6079 Aquafall Flat	M53 Dryfall Flat
	2 nd Coat	DF 12 Dryfall Flat	W 6079 Aquafall Flat	M53 Dryfall Flat
Particle Board, MDF, and Hardboard Surfaces: 100% Acrylic FLAT				
	1 st Coat	4000 Uniprime II	UGPR00 Ultra-Grip	N023 Fresh Start Primer
	2 nd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
	3 rd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
Particle Board, MDF, and Hardboard Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4000 Uniprime II	UGPR00 Ultra-Grip	N023 Fresh Start Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
Particle Board, MDF, and Hardboard Surfaces: 100% Acrylic GLOSS				
	1 st Coat	4000 Uniprime II	UGPR00 Ultra-Grip	N023 Fresh Start Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Portland Cement Plaster Surfaces: 100% Acrylic FLAT				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
	3 rd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
Portland Cement Plaster Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	7500 Acriglo Eggshell	SPMA30 Suprema LS	550 Regal Select Pearl
	3 rd Coat	7500 Acriglo Eggshell	SPMA30 Suprema LS	550 Regal Select Pearl

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Portland Cement Plaster Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
	3 rd Coat	7000 Acriglo Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
Portland Cement Plaster Surfaces: 100% Acrylic GLOSS				
	1 st Coat	4600 Uniprime II	ESPR00 Eff-Stop Premium	N023 Fresh Start Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Portland Cement Plaster Surfaces: 100% Epoxy GLOSS				
	1 st Coat	4600 Uniprime II	Rust-Oleum S70/S71 WB	N023 Fresh Start Primer
	2 nd Coat	Rust-Oleum Sierra S60 Gloss WB Epoxy	Rust-Oleum Sierra S60 Gloss WB Epoxy	P43 Super Spec HP Gloss Epoxy
Gypsum Board Surfaces: 100% Acrylic FLAT				
	1 st Coat	N/A	VNPR00 Vinylastic Premium	NA
	2 nd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
	3 rd Coat	7100 Acriglo Flat	SPMA10 Suprema Flat	547 Regal Select Flat
Gypsum Board Surfaces: 100% Acrylic LOW SHEEN				
	1 st Coat	5001 Vpro Primer	VNPR00 Vinylastic Premium	N023 Fresh Start Primer
	2 nd Coat	5200 Vpro Low Sheen	SPMA20 Suprema VS	549 Regal Select Eggshell
	3 rd Coat	5200 Vpro Low Sheen	SPMA20 Suprema VS	549 Regal Select Eggshell
Gypsum Board Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	5001 Vpro Primer	VNPR00 Vinylastic Premium	N023 Fresh Start Primer
	2 nd Coat	5300 Vpro Eggshell	SPMA30 Suprema LS	550 Regal Select Pearl
	3 rd Coat	5300 Vpro Eggshell	SPMA30 Suprema LS	550 Regal Select Pearl

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Gypsum Board Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	VNPR00 Vinylastic Premium	N023 Fresh Start Primer
	2 nd Coat	5400 Vpro Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	SPMA50 Suprema Semi Gloss	551 Regal Select Semi Gloss
Gypsum Board Surfaces: 100% Acrylic GLOSS				
	1 st Coat	5001 Vpro Primer	VNPR00 Vinylastic Premium	N023 Fresh Start Primer
	2 nd Coat	8500 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
	3 rd Coat	8501 Carefree Gloss	EVSH 60 Evershield Gloss	794 Advance High Gloss
Gypsum Board Surfaces: 100% Epoxy GLOSS				
	1 st Coat	5001 Vpro Primer	Rust-Oleum Sierra S70/S71 WB Epoxy Acrylic Primer	N/A
	2 nd Coat	Rust-Oleum Sierra S60 Gloss WB Epoxy	Rust-Oleum Sierra S60 Gloss WB Epoxy	N/A
Acoustical Tile Surfaces: 100% Acrylic FLAT				
	1 st Coat	013 Acoustic Kote	W 615 Acoustikote	258 Moore's Ceiling White
	2 nd Coat	013 Acoustic Kote	W 615 Acoustikote	258 Moore's Ceiling White
INTERIOR SURFACES - ZERO VOC				
Concrete Surfaces: Acrylic FLAT				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	3 rd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
Concrete Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
	3 rd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Concrete Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
CMU Surfaces: Acrylic FLAT				
	1 st Coat	040 Block Kote	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	3 rd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
CMU Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	040 Block Kote	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
	3 rd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
CMU Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	040 Block Kote	SBPR00 Blockfill	160 Latex Block Filler
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
Iron & Steel Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	9600 Protec	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
Aluminum Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	4800 Metal Pro Primer	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
<u>Stainless Steel, Copper, and Brass Surfaces:</u> 100% Acrylic SEMI-GLOSS				
	1 st Coat	4800 Metal Pro Primer	UGPR00 Ultra-Grip	P04 Acrylic Metal Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
<u>Finished Wood Surfaces:</u> 100% Acrylic EGGSHELL				
	1 st Coat	5001 Vpro Primer	UGPR00 Ultra-Grip	511 Natura Primer
	2 nd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
	3 rd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
<u>Finished Wood Surfaces:</u> 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	UGPR00 Ultra-Grip	511 Natura Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
<u>Particle Board, MDF, and Hardboard Surfaces:</u> Acrylic FLAT				
	1 st Coat	5001 Vpro Primer	UGPR00 Ultra-Grip	511 Natura Primer
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	3 rd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
<u>Particle Board, MDF, and Hardboard Surfaces:</u> 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	UGPR00 Ultra-Grip	511 Natura Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
Portland Cement Plaster Surfaces: Acrylic FLAT				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	3 rd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
Portland Cement Plaster Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
	3 rd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
Portland Cement Plaster Surfaces: 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
Gypsum Board Surfaces: Acrylic FLAT				
	1 st Coat	Not Required	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	3 rd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
Gypsum Board Surfaces: 100% Acrylic EGGSHELL				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell
	3 rd Coat	5300 Vpro Eggshell	EVER 30 Everest Eggshell	513 Natura Eggshell

SUBSTRATE	NO. OF COATS	VISTA PAINT	DUNN-EDWARDS	BENJAMIN MOORE
<u>Gypsum Board Surfaces:</u> 100% Acrylic SEMI-GLOSS				
	1 st Coat	5001 Vpro Primer	VNSL00 Vinylastic Select Primer	511 Natura Primer
	2 nd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
	3 rd Coat	5400 Vpro Semi-Gloss	EVER 50 Everest Semi Gloss	514 Natura Semi Gloss
<u>Acoustical Tile Surfaces:</u> Acrylic FLAT				
	1 st Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat
	2 nd Coat	5100 Vpro Flat	EVER 10 Everest Flat	512 Natura Flat

SECTION 099623 - ANTI GRAFFITI COATING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this section.
- B. Description: This Section includes the application of an anti-graffiti coating system to protect the above-grade exterior surfaces including, but not limited to:
 - 1. Stained or "specially finished" concrete (as indicated on elevations)
 - 2. CMU walls (as indicated on elevations)
 - 3. Stone or stone like veneer.
 - 4. Brick Veneer
 - 5. Stucco
 - 6. Wood (as indicated on elevations)
 - 7. Benches
 - 8. Any other exterior architectural element(s) as indicated on elevations
- C. Coatings: As used herein, means all graffiti resistant coating system materials, including base coatings and top coating required to achieve the performance requirements of this Section
 - 1. Clear (transparent) graffiti resistant coating.
 - 2. Pigmented graffiti resistant coating.

1.2 SECTION INCLUDES:

- A. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- B. Section 033100 - Cast-In-Place Concrete
- C. Section 042200 - Unit Masonry
- D. Section 099113 - Painting

1.3 SUSTAINABILITY

- A. As required in California 2013 Green Building Standards Code, Chapter 5, Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3, unless more stringent local limits apply.

1.4 REFERENCES:

- A. Coatings must comply with South Coast Air Quality Management District (SCAQMD) Rule 1168 VOC limits. OR RULE 1113 IS THE APPLICABLE SCAQMD RULE RE ARCHITECTURAL COATINGS AND IS PROBABLY MORE APPROPRIATE UNLESS SOME SPECIAL NEED TO REFER TO ADHESIVES AND SEALANTS.
- B. ASTM D2369-92 - Test methods for Volatile Contents of Coatings.
- C. ASTM D3960-93 - Practice for Volatile Organic Compounds (VOC) Contents of Paints and Related Coatings.
- D. ASTM B-1 17 and ASTM D-714 (Salt spray Test): 10,000 Hours.
- E. ASTM D-522 (Flexibility Strength Test): Pass 3/8" mandrel.
- F. ASTM D-968 (Abrasion Test): 10 liters of sand to abrade 1 mil of dry coating.
- G. ASTM E-96-93 (Vapor Transmission Test): Vapor is transmitted.
- H. ASTM D-3359-90 (Adhesion Test): 5A
- I. ASTM D-610-85 (Rust): Less than 0.03% degradation.

1.5 SYSTEM DESCRIPTION

- A. Base coating and graffiti resistant top coating shall each be a permanent coating system.
- B. Product shall be suited to architectural aesthetics of substrate and shall come in clear or color with a choice of finishes including dead flat, semigloss, or high gloss.
 - 1. Finishes-must be measurable on a 60 degree meter to read not greater than:
 - a. 5 flat finishes
 - b. 45 to 55 for semigloss finishes
 - c. not less than 75 for high gloss finishes
- C. Anti-graffiti coating shall show no signs of deterioration or change of appearance after graffiti has been removed during the 20-year warranty period: i.e., no shadowing, ghosting, or staining of coating or substrate.

- D. Anti-graffiti coating shall be non-yellowing, non-chalking, and UV resistant. Graffiti removal product shall be non-toxic, non-flammable, biodegradable, and with a neutral pH with a range between 7.0 and 8.5.
- E. Dirt pickup on the substrate shall not be increased by the application of the anti-graffiti system.
- F. Anti-graffiti coatings shall conform to current City and State waste disposal regulations at date of installation.
- G. Anti-graffiti coatings shall be AQMD/VOC compliant.
- H. Anti-graffiti coating shall equal or exceed the following standards for the chemical materials listed:

1. (NE=No Effect)

MEK	NE after 5 days
Acetic Acid 100%	NE
Carboxylic Acid	NE after 5 days
Sodium Hydroxide 100%	NE
Phosphoric Acid 75%	NE after 5 days
Aniline	NE
Hydrochloric Acid 37%	NE 4 hour blister
Toluene	NE
Gasoline	NE
Sulfuric Acid 50%	NE after 5 days
Skydrol	NE
Nitric Acid 20%	NE 68 hour blister
Motor Oil	NE
IPA	NE
Acid Rain	NE
MEK double rubs	500+

1.6 SUBMITTALS

- A. Product data: Submit manufacturer's product data sheets on products to be used for the Work.
 - 1. Base Coating.
 - 2. Anti-graffiti top coating.
 - 3. Graffiti removal agent.
- B. Test Report: If requested, submit copies of the following reports:

1. Certified test reports indicating compliance with the requirements of ASTM D-2369-92, ASTM D-3960-93, ASTM B-1 17, ASTM D-714, ASTM D-52Z ASTM D-968, ASTM E-96-93, ASTM D-3359-90, ASTM D-61 0-85.
- C. Samples for initial color verification: Submit manufacturer's sample custom color match of Architect's color sample.
- D. Samples for verification: Submit each color and material to be applied on surface to simulate actual field conditions as follows:
 1. Twelve inch (12") square samples.
- E. Applicator Qualifications
 1. Manufacturer's certification or pre-training letter approving of applicator or willingness to train applicator if awarded sub-contract for this anti-graffiti portion of the work.
 2. A list of recently completed graffiti resistant coating projects. Supply name and location of project name and telephone number of owner and architect, and a description of products used, substrates, applicable local environmental regulations, and application procedures.
- F. Environmental Regulations: Submit certification that products conform to applicable local environmental regulations.
- G. Protection Requirements: Submit description of plans for protection barriers of surrounding areas and non-masonry surfaces, surface preparation for application, and final cleaning.
- H. Maintenance Requirements: Submit manufacturer's instructions for graffiti removal procedures.
- I. Sustainable Design Submittals
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.7 MOCK-UP TEST PANEL

- A. Apply base coating and graffiti resistant top coating to test areas to determine number of coats, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.
- B. Apply material to test panels in accordance with manufacturer's written Instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. Do not begin full-scale application until test panels are reviewed and accepted by the Owner ABS rev.01/09/01 - Rev 04/04/01
- C. Test Panel Requirements:
 - 1. Area: Minimum 4 feet by 4 feet.
 - 2. Locations: As determined by Owner
 - 3. Each type of substrate that will be protected

1.8 QUALITY ASSURANCE

- A. Applicator
 - 1. Applicator shall be experienced in coating applications, and shall be currently a Certified Applicator in Good Standing and/or will become certified per the Manufacturer's training procedures during the project with the graffiti resistant coatings as specified in this section.
- B. Pre-Application Meeting: Convene a pre-application meeting before the start of application of graffiti resistant coating. Require attendance of parties directly affecting Work of this Section, Including the General Contractor, Owner, Certified Applicator, and Manufacturer's Representative. Review environmental regulations, test panel procedures, protection of the surrounding areas and non-masonry surfaces, surface preparation, application, field quality control, final cleaning, and coordination with other Work.
- C. Single Source Responsibility: Same manufacturer will supply base coatings, top coatings and all removal agents.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, bearing manufacturer's name label with the following information:
 - 1. Name of the material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Manufacturer's name.
 - 4. Contents by volume for major pigment and vehicle constituents.
 - 5. Application instructions.

6. Color name and number (if applicable).

- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of coating materials in a clean condition, free of foreign materials and residue.
- C. Protect from freezing where necessary. Keep storage area neat and orderly. Remove flammable rags and waste daily. Take precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing, and application of coatings.

1.10 PROJECT/SITE CONDITIONS

- A. Temperature Limitations:
 - 1. Apply water-based coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 degrees F and 95 degrees F, unless permitted by paint manufacturer's printed Instructions.
 - 2. Apply solvent-based coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 degrees F and 95 degrees F, unless permitted by paint manufacturer's printed instructions
- B. Apply per manufacturer's Instructions.
- C. Do not apply under windy conditions such that base coating and/or graffiti resistant coating may be blown to surfaces not other than those being treated.
- D. Do not apply to frozen substrate. Do not apply coatings when ambient temperature is expected to fall below 40 degrees F for 24 hours after application unless surface is protected and heated.
- E. Do not apply earlier than 24 hours after rain, snow, fog, or mist if same is predicted for a period of 12 hours after application.
- F. This specification, the manufacturer's specifications, and MSDS sheets are to be on the job site during application. Applicators shall be thoroughly familiar with their content.

1.11 WARRANTY

- A. Warranty must be issued by manufacturer prior to final payment to subcontractor.
- B. Warranty shall cover the original purchaser or property owner for a period of twenty (20) years from the date of Grand Opening.
- C. Manufacturer shall warrant the performance for its products for the warranty period and the removal of graffiti defacement, chemical staining, ghosting, shadowing and normal environmental effects, without exception, and shall retain reasonable gloss and color stability so long as product is applied according to the manufacturer's recommendations. Warranty shall be issued only upon successful application of the products and verification

that products were properly applied by showing successful graffiti removal. Once warranty is issued, manufacturer will bear responsibility for repair, remediation of any substrate and replacement of coatings if there is a failure of the products to protect the substrates and the coatings from damage from graffiti. Manufacturer shall not be responsible for water conditions, structural defects, damage to coatings from external forces, or similar causes.

- D. Manufacturer shall warrant that coating will perform as stated herein for the entire warranty period.
- E. Surface shall endure unlimited clean-downs with no damage to the coating or substrate.

1.12 INSTRUCTIONS

- A. Subcontractor shall provide demonstration of cleaning procedure per manufacturer's Instructions to tenant's or property owner's representative after completion of application and surface has properly cured. Owner will coordinate the meeting.

1.13 MAINTENANCE

- A. Extra Products: Furnish the following extra products: Graffiti removal agent -- One and one-half (1.5) gallons per 2,500 square feet of covered area. GSS TYPICALLY PACKAGES IN A SINGLE CASE – TWELVE 16oz. bottles which equals 1.5 gallons.
 - 1. Removal agent shall be packaged in 16 to 32 oz. bottles and boxed for storage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Graffiti resistant coating shall be a clear, non-sacrificial graffiti resistant coating which provides protection for exterior vertical surfaces from permanent graffiti staining and damage caused by any type of commercially available spray or other paint, stains, inks, and marking pens. Coating shall be suitable for application to painted and unpainted surfaces including masonry, concrete, metals, and EIFS. Product shall be a coating that dries clear, non-yellowing, non-chalking with a sheen of <5° on the Gardner Gloss Meter for flat finish top coats.
 - 1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following products as manufactured by GSS Coatings, LLC, South Jordan, UT; 801-255-9505. www.gsscoatings.com . or approved equal (any submittals for alternates must be made and approved prior to bid).
 - a. Base Coat: GSS-307 Base Coat
 - b. Top Coat: GSS-100 Top Coat or other related top coats depending on required sheen and/or tint.
 - c. Cleaning Solution: GSS-400 ERASOL Graffiti Cleaning Solution

- B. Water Repellant (For first coat on unpainted concrete and masonry surfaces): GSS-500 Aqua-Lock WB Water Repellent & Concrete Sealer, as specified in Section 071900.

2.2 MATERIAL CHARACTERISTICS

- A. Anti-graffiti coatings shall be multi-component, multi-coat coating system. Single component systems are not acceptable.
- B. Anti-graffiti coating shall not contain paraffin (wax) or elastomeric silicones.
- C. Anti-graffiti coating shall have the capability of having all types of paints and graffiti materials (currently known to the general public) completely removed without damaging the anti-graffiti top coating, the base coating or the substrate.
- D. Removal agent shall be non-toxic, non-flammable, biodegradable, and have a pH 7 to 8.5. After removal is complete, no evidence of graffiti shall be present.
- E. The removal of graffiti material shall not cause a change in the appearance of the treated surface for the period of the warranty; i.e., there shall be no shadowing, ghosting, or staining of coating or substrate.
- F. Color Selection (for pigmented coatings as required):
 - 1. Custom color: Match color sample.
- G. SUSTAINABLE MATERIALS - LEED
 - 1. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - a. 018113 Sustainable Design Requirements
 - 2. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria
 - a. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - b. Preference is given to product-specific type III EPDs
 - c. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline
 - 3. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria
 - a. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.

- b. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation
 - c. Preference is given to product inventoried to at least 0.01% (100 ppm)
 - d. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher
 - e. Preference is given to Declare labels designated as Red List Free
4. Low-Emitting Materials criteria
- a. VOC content criteria
 - 1) For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - c. VOC emissions criteria or inherently non-emitting
 - 1) All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria
 - a) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits
 - b) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Applicator shall examine areas and conditions under which anti-graffiti coating is to be applied. Applicator shall notify General Contractor and Owner in writing of conditions detrimental to proper and timely completion. Applicator to ensure that any acidic cleaner has been removed and that substrates to be treated are free of contaminants and are pH neutral prior to application of anti-graffiti coatings. Applicator shall not proceed with Work until unsatisfactory conditions have been corrected.
- B. Commencement of coating work shall be construed as Applicator's acceptance of surfaces and conditions within any particular area and Applicator's representation that the surface has been properly treated, cleaned, or repainted.
- C. Unpainted Concrete and Masonry: Verify water repellent has been applied in accordance with Section 071900 to new or non-painted concrete and masonry surfaces prior to the application of the anti-graffiti coating.

- D. Do not apply over dirt, rust scale, grease, moisture, or conditions otherwise detrimental to formation of a durable base coating

3.2 PREPARATION

- A. General: Perform preparation and cleaning procedures with coating manufacturer's instruction and as herein specified for each particular substrate condition.
- B. Repair, patch, and fill cracks, voids. Defects and damaged areas in surface as approved by the Owner.
- C. Allow repair materials to cure completely before application of graffiti resistant coatings.
- D. Apply specified sealant and caulking and allow to each cure completely before application of graffiti resistant coatings.
- E. Seal all open joints with sealant approved for substrate and acceptable by coatings manufacturer.
- F. Allow masonry, concrete construction and repainted surfaces to cure completely before applying graffiti resistant coatings.

3.3 APPLICATION

- A. General: Apply anti-graffiti coating in accordance with manufacturer's directions. Use application techniques best suited for substrate and type of material to be applied.
- B. Applicator shall know the substrate that is to be coated and understand the porosity, texture, and general conditions that will be present during the application to provide a correct bid and choose correct product acquisition. Applicator responsible for ensuring that correct wet and dry mil thicknesses achieved as per manufacturer's specifications.
- C. Do not dilute anti-graffiti products, materials shall be used direct from the manufacturer's containers.
- D. Mix anti-graffiti coatings two-component products at ratio stated by the manufacturer.
- E. Applicator shall use caution when spraying coatings. Applicator shall wear a respirator with an organic vapor cartridge. Avoid over-spray and spillage. Mask all windows, move vehicles, cover air intakes, cover vegetation, place barriers to keep pedestrians away from the spraying materials. Applicator shall make sure there is adequate ventilation. Applicator should use an air line respirator if ventilation is not adequate.
- F. Do not apply in windy conditions.

3.4 APPLICATION RATES

- A. Base Coatings:
 - 1. All base coatings require an application of at least two (2) coats on all surfaces. If two (2) coat does not result in a continuous, pin-hole free coating, additional coats must be applied until a pin-hole free surface is achieved.
 - 2. Allow a minimum of 24 hours between base coatings and anti-graffiti top coating.
 - 3. Anti-graffiti top coatings require an application of at least two (2) coat on all surfaces. (With the exception of split face block. Please contact manufacturer.) Dry mil thickness of 3.5-4 anti-graffiti top coating must be achieved per manufacturer's specifications.
- B. Apply at 3.5 - 4.0 mils dry (7.0 - 8.0 mils wet) per coat to achieve optimal performance.
- C. Apply coatings in a crosshatch pattern. One vertical pass and one horizontal pass are considered one coat.
- D. Back roll base coating when applying to an uneven or textured substrate to achieve a continuous pinhole free surface.
- E. Top coating may not require back rolling. Consult with manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Inspection: Inspect the graffiti resistant coatings Work with the General Contractor, Owner, and Applicator and compare with test panel results accepted by the Owner. Subcontractor to comply with manufacturer's requirements for issuance of warranty.
- B. Touch-up Work: Surface areas determined to be un-coated or not consistent with desired finish shall be repaired per manufacturer's written instruction.
- C. Manufacturer's Field Services: Provide the services of a manufacturer's authorized representative to verify specified products are used, and protection, surface preparation, and application of graffiti resistant coatings are in accordance with the manufacturer's written instructions and the test panel results accepted by the Owner.

3.6 CLEANING

- A. Clean site of all unused graffiti resistant coatings, residues, rinse water wastes, and effluent in accordance with environmental regulations.
- B. Remove and dispose of all materials used to protect surrounding areas and non-masonry surfaces, following completion of the Work of this Section.
- C. Repair, restore, or replace to the satisfaction of the, all materials, landscaping, and non-masonry surfaces damaged by exposure to graffiti resistant coatings.

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END OF SECTION 099623

SECTION 09 97 13 – HIGH-PERFORMANCE STEEL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Field-applied high-performance steel coatings applied to exterior exposed-in-service ferrous metal (iron and steel) surfaces (SSPC Environmental Zones 1B, 2A, and 2B).
2. Surface preparation.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.
2. Section 09 91 00 for painting steel surfaces installed in SSPC Environmental Zones 0 and 1A, including field-applied primers and spot primers.

1.2 RELATED DOCUMENTS

- ##### A.
- This specification supplements the requirements to define complete high-performance steel coating systems.

1.3 REFERENCES

A. Definitions:

1. Manufacturer: Means the high-performance coating manufacturer, unless otherwise indicated.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selected coating for compatibility with chemicals used near or on coated surfaces, including cleaning materials, accessories, and methods.
2. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified high-performance coatings are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
3. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then

- a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.
4. Master Painters Institute standards are insufficient for and not applicable to this project.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 1. Product Data:
 - a. Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
 2. Samples: Submit 8-1/2-inch by 11-inch drawdown cards of each specified color and sheen. Label each card with project location.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished high-performance coatings.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Maintenance Material Submittals:
 1. Before Final Completion, deliver to the Owner extra stock materials to replace those worn or damaged as a result of normal occupancy.

2. Furnish one unopened gallon or container for each high-performance coating type, color, composition, grade, finish, and variety.
3. Submit manufacturer-recommended cleaning materials, accessories, and manufacturer's instructions and other requirements and recommendations for maintenance and cleaning of coated surfaces, including a comprehensive list of known chemicals that should not come into contact with coated surfaces.

E. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing high-performance coatings for at least 30 previous projects similar to this project in size, material, design, and complexity. Only a company certified by the SSPC as having a current QP1 certification may apply high-performance coatings.
2. Supervisors: Individuals must have at least 7 years' experience installing high-performance coatings for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading high-performance coating installers.

- B. Mockups: If an *ex-situ* exterior wall integrated mockup is required for this project, then integrate high-performance coatings into the mockup as part of the work of this specification section.

1.7 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.

3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
 1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor and from deterioration and damage.
 3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
 1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective high-performance coatings with undamaged new high-performance coatings that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.8 PROJECT CONDITIONS

- A. Ambient Conditions: Install high-performance coatings only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
- B. Existing Conditions:
 1. Surface Conditions: Surfaces receiving high-performance coatings must be dry. Install high-performance coatings only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Other Conditions: Do not apply high-performance coatings where dust is generated, or liquids are sprayed.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:

1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Paints and coatings to meet the California Air Resource Board (CARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings.
 - 1) Refer to Section 018113 for VOC content limits.
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Carboline Co.
 - 2. PPG Industries, Inc.
 - 3. Tnemec Co.

2.3 HIGH PERFORMANCE COATING

- A. Spot Primer for Unprimed and Zinc-Rich-Primed Surfaces:
 - 1. Description: Zinc-rich organic primer conforming to SSPC-Paint 20 Type II (Organic) zinc-rich primers and AISC requirements for Class B surface slip coefficient rating (minimum mean slip coefficient of at least 0.50).
 - 2. Product: "94-H2O Hydro-Zinc" manufactured by the Tnemec Co., or equal.
 - 3. Requisite Properties:
 - a. Minimum Thickness: Apply to a DFT of between 2.5 and 3.5 mils, when measured in conformance with SSPC paint application standard SSPC-PA2, "*Measurement of Dry Coating Thickness with Magnetic Gages*".
 - b. Colors: Reddish-gray or other standard color furnished by the primer manufacturer.
 - 4. Performance Requirements:
 - a. Zinc Dust Pigment: ASTM D 520 Type III composition classification (maximum 0.002 percent lead).
 - b. Dry Film Adhesion: At least 800 pounds per square inch pull, when tested in conformance with ASTM D 4541.
 - c. Humidity Resistance: No blistering, cracking, rusting, or film delamination after at least 1,000 hours exposure, when tested in conformance with ASTM D 4585.
 - d. Salt Spray Resistance: No blistering, cracking, rusting, or film delamination; nor more than 1/32-inch rust creep at scribe after at least 10,000 hours exposure, when tested in conformance with ASTM B 117.
- B. Spot Primer for Other Shop-Primed Surfaces: Provide spot primer identical to the shop primer originally used to prime metal surfaces.
- C. Epoxy Intermediate Coat:
 - 1. Product: "Hi-Build Epoxoline II Series L69" manufactured by the Tnemec Co., or equal.
 - 2. Requisite Properties:
 - a. Material: 2-component polyamidoamine epoxy.

- b. Minimum Thickness: Apply to a DFT of between 6.0 and 10.0 mils per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, *"Measurement of Dry Coating Thickness with Magnetic Gages"*.
- c. Color: Match Tnemec color 10BL, "Cornflower".
- d. Specular Gloss (Sheen): Satin.
- 3. Performance Requirements:
 - a. Dry Film Adhesion: Minimum rating of 5, when tested in conformance with ASTM D 3359.
 - b. Humidity Resistance: No blistering, cracking, rusting or delaminating of film after minimum 1,000 hours exposure, when tested in conformance with ASTM D 4585.
 - c. Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film; and not more than 3/16-inch rust creep at scribe after 10,000 hours exposure, when tested in conformance with ASTM B 117.

D. Aliphatic Polyurethane Topcoat:

- 1. Product: "1095 Endura-Shield" manufactured by the Tnemec Co., or equal.
- 2. Requisite Properties:
 - a. Material: Aliphatic acrylic polyurethane.
 - b. Minimum Thickness: Apply to a DFT of between 3.0 and 6.0 mils per coat, when measured in conformance with SSPC paint application standard SSPC-PA2, *"Measurement of Dry Coating Thickness with Magnetic Gages"*.
 - c. Color: Selected by the Architect.
 - d. Specular Gloss (Sheen): Semi-gloss.
- 3. Performance Requirements:
 - a. Dry Film Adhesion: At least 1,260 pounds per square inch pull, when tested in conformance with ASTM D 441, (Method E, Type V Tester) , average of 3 tests.
 - b. Humidity Resistance: No blistering, cracking, rusting, or delaminating of film after minimum 5,000 hours exposure, when tested in conformance with ASTM D 4585.
 - c. UV Resistance: No blistering, cracking, or delamination, and not less than 58 percent gloss retention or 15.2 units gloss change and 1.40 DECIE2000 color change (white) after 4,000 hours exposure.
 - d. Salt Spray Resistance: No blistering, cracking, rusting, or delaminating of film; or rust creep after 5,000 hours exposure, when tested in conformance with ASTM B 117.

2.4 SURFACE PREPARATION

A. Unprimed Iron and Steel Surfaces:

- 1. Normally-Dry Interior Exposed-In-Service Conditions: Prepare surfaces in conformance with the primer manufacturer's application instructions and SSPC-SP-3, *"Power Tool Cleaning"*.
- 2. Elsewhere: Prepare surfaces in conformance with primer manufacturer's application instructions and SSPC-SP-11, *"Power Tool Cleaning to Bare Metal"*.

- B. Shop-Primed Iron and Steel Surfaces:
 - 1. Clean damaged primer areas and prepare damaged primer and adjacent surfaces in conformance with the steel coating manufacturer's application instructions and SSPC-SP-11, *"Power Tool Cleaning to Bare Metal"*.
 - 2. Sand smooth and re-clean.
 - 3. Spot-prime bare metal surfaces with specified spot-primer applied to a minimum total spot primer DFT of between 2.5 and 3.5 mils.
 - 4. Overlap undamaged primer areas with spot primer a minimum of at least 2 inches.
- C. Unknown or Incompatible Primer: Apply full prime coat of specified spot primer on all surfaces as a tie-coat for subsequent intermediate and top coats.

2.5 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.6 MIXING

- A. Open high-performance coating containers only as required for use and mix only in designated areas.
- B. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- C. Do not reduce, alter, or introduce foreign materials into high-performance coatings, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with high-performance coating adhesion, appearance, or performance.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

A. Protection:

1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and high-performance coating installation.
2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
3. Opening Protection: Close and protect drains and other openings and penetrations to prevent high-performance coating intrusion or migration of liquids.

B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

A. General Requirements:

1. Install high-performance coatings using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Only install high-performance coatings under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. high-performance coating surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Completed work must match approved samples and mockups, as accepted by the Architect.
6. Installed high-performance coatings must be warrantable. Do not install, correct, or replace high-performance coatings in a manner that results in any warranty or guarantee becoming void.

3.4 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including

arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect high-performance coatings in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against high-performance coatings unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed high-performance coatings as work surfaces.

END OF SECTION

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SECTION 09 97 23 – PENETRATING CONCRETE FLOOR SEALER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrating concrete floor sealer.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the concrete sealer manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify chemical and adhesive compatibility of selected concrete sealer with installed curing compounds and installed moisture vapor emission control systems, based on current product formulations.
2. Coordinate selected sealer for compatibility with chemicals used near or on coated surfaces, including cleaning materials, accessories, and methods.
3. Proposed substitution requests and submittals that change the quality (grade) or generic chemistry of specified concrete sealers are prohibited and returned to the Contractor without review or responsive action, except to record non-conformance with this requirement.
4. Specified coverage rates and thicknesses are minimum. If manufacturer's recommended coverage rates differ from specified rates, then
 - a. consult the manufacturer's representative and obtain manufacturer-recommended coverage rates printed on manufacturer's letterhead;
 - b. assume the manufacturer-recommended coverage rates govern; and
 - c. promptly submit an RFI to the Architect for resolution; include manufacturer-recommended coverage rates with the RFI.

B. Sequencing:

1. Install concrete sealers only after concrete is cured to a condition of equilibrium; is sufficiently dry to bond with concrete sealers; and has alkalinity (pH), MVER, and RH within ranges required, recommended, or accepted by the manufacturer.
 2. Either delay concrete sealer installation until after joint sealant installation is complete, or protect sealant bond surfaces to prevent concrete sealer migration onto joint surfaces. concrete sealer application may only precede sealant application after sealant adhesion and compatibility are tested and verified using substrates, concrete sealers, and sealant materials identical to those used in the work.
- C. Scheduling: Allow enough time in the construction schedule for concrete to cure for at least 28 days before beginning surface preparation and installation.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
1. Product Data: Submit manufacturer's product data, specifications, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished concrete sealers.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
 2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.
- C. Maintenance Material Submittals:
1. Before Final Completion, deliver to the Owner extra stock materials to replace those worn or damaged as a result of normal occupancy.
 2. Furnish one unopened gallon or container for each concrete sealer type, color, composition, grade, finish, and variety.
 3. Submit manufacturer-recommended cleaning materials, accessories, and manufacturer's instructions and other requirements and recommendations for maintenance and cleaning of sealed surfaces, including a comprehensive list of known chemicals that should not come into contact with sealed surfaces.
- D. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installer: Company or individuals must have at least 5 years' experience installing concrete sealers for at least 30 previous projects similar to this project in size, material, design, and complexity.
2. Supervisors: Individuals must have at least 7 years' experience installing concrete sealers for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading concrete sealer installers.

1.6 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

1. Furnish adequate dunnage and bracing during storage.
2. Prevent stored items from contacting the floor and from deterioration and damage.
3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.

C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.

1. Avoid damage to packaging and containers, and contamination of contents.
 2. Rotate inventory; do not use items the shelf life of which is expired.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective concrete sealers with undamaged new concrete sealers that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 PROJECT CONDITIONS

- A. Ambient Conditions: Install concrete sealers only when ambient temperature, RH, and other environmental conditions fall within ranges required, recommended, or accepted by the manufacturer.
1. Do not install concrete sealers during rain or snow, fog or mist; or when rain or snow is predicted within 24 hours of installation.
 2. Proceed only when there is no threat of impending precipitation, and both current and forecasted weather conditions conform to those required, recommended, or accepted by the manufacturer.
 3. Do not apply concrete sealers when
 - a. ambient temperature is below 45 deg. F or more than 90 deg. F during application, and for at least 8 hours after;
 - b. surface temperatures are less than 40 deg. F or greater than 120 deg. F; and
 - c. surface temperatures are 5 deg. F or less above the dew point.
- B. Existing Conditions:
1. Surface Conditions: Surfaces receiving concrete sealers must be dry. Install concrete sealers only when substrate moisture content and surface temperature fall within ranges required, recommended, or accepted by the manufacturer.
 2. Other Conditions: Do not apply concrete sealers where dust is generated, or liquids are sprayed; or when windy conditions exist that may cause concrete sealers to be blown onto vegetation or other unintended surfaces.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements

- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 PENETRATING CONCRETE FLOOR SEALER

- A. Description: Clear-drying, water-based silane or siloxane water repellent sealer for interior exposed concrete slabs.
- B. Product: "Sure Klean Weather Seal Siloxane WB Concentrate" manufactured by PROSOCO, Inc., or equal.
 - 1. Porous Surfaces (e.g., Concrete Brick, Concrete Pavers, and Concrete Tile): Dilute to 1 part concentrate to not more than 7 parts water.
 - 2. Semi-Porous Surfaces (e.g., Cast-in-Place Concrete, Precast Concrete, Clay Brick, Terra Cotta, and Unpolished Sandstone): Dilute to 1 part concentrate to not more than 9 parts water.
 - 3. Dense Surfaces: Dilute to 1 part concentrate to not more than 14 parts water.
- C. Requisite Properties: When compared visually to an untreated sample under the same lighting conditions, concrete sealers may not alter the color or sheen of the coated substrate and must be invisible after application and over the life of the substrate. Confirm visual appearance by mockups and adjust products and applications as required.

2.3 ACCESSORIES

- A. Mix Water: Provide fresh, clean, clear, potable water from a domestic source. Water must conform to ASTM C 1602 and be free of oil, grease, waxy films, curing compounds, release agents, and other deleterious materials, including salts, acids, alkalis, organic materials, detergents, and other matter that might negatively affect tile quality, durability, or performance.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.4 MIXING

- A. Open concrete sealer containers only as required for use and mix only in designated areas.
- B. Thoroughly agitate and stir materials to a uniform and smooth consistency suitable for proper installation.
- C. Do not reduce, alter, or introduce foreign materials into concrete sealers, except in conformance with manufacturer's instructions and other requirements and recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification:
 - 1. Verify in-place construction, project conditions, and the work of other specification sections conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Verify substrates are dry and free of curing compounds, sealers, hardeners, and deleterious and other substances that might interfere with concrete sealer adhesion, appearance, or performance.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 PREPARATION

- A. Protection:
 - 1. Work Area Protection: Protect work areas from dust and other airborne contaminants during surface preparation and concrete sealer installation.
 - 2. Adjacent Material Protection: Protect adjacent surfaces against soiling and damage. Utilize drop cloths, shields, masking, barricades, and other items necessary to protect adjacent surfaces.
 - 3. Opening Protection: Close and protect drains and other openings and penetrations to prevent concrete sealer intrusion or migration of liquids.
- B. Substrate Preparation: Prepare substrates as required, recommended, or accepted by the manufacturer without limitation; and in a manner that does not result in any warranty or guarantee becoming void.

3.3 INSTALLATION

- A. General Requirements:
 - 1. Install concrete sealers using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Only install concrete sealers under conditions that ensure finishes are free from blemishes and defects.
3. Provide smooth surfaces of uniform finish, color, appearance, and coverage. concrete sealer surfaces with cloudiness, spotting, holidays, runs, or other imperfections are prohibited and are rejected as non-conforming work.
4. Do not exceed the application rates recommended by the manufacturer.
5. Installed concrete sealers must be warrantable. Do not install, correct, or replace concrete sealers in a manner that results in any warranty or guarantee becoming void.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect sealed concrete in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against sealed concrete unless it is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed sealed concrete surfaces as work surfaces.

END OF SECTION

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DIVISION 10

SPECIALTIES

SECTION 10 11 16 – MARKERBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass markerboards.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the markerboard manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples:
 - a. Submit at least 8-inch square representative samples of each markerboard color, finish, and variety.
 - b. Submit at least 8-inch long representative samples of each markerboard trim type, color, finish, and variety.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Submit manufacturer-prepared published instructions for proper installation of furnished markerboards.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for markerboard maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
1. Markerboards must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.

2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective markerboards with undamaged new markerboards that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Claridge Products and Equipment, Inc.
 2. Clarus Glassboards.
 3. MorreCo Inc.
 4. PolyVision Corp.

2.2 GLASS MARKERBOARDS

- A. Description: 1/4-inch low-iron, back-painted, magnetic glass markerboard with concealed z-bar mount.
- B. Products: "Architectural Glass Markerboard" manufactured by Claridge Products and Equipment, Inc., or equal.
- C. Requisite Properties:
1. Size: Indicated on the Drawings.
 2. Orientation: Landscape.
 3. Mounting Height: Indicated on the Drawings.
 4. Mounting: "Invisi-Mount".
 5. Color: Indicated on the Drawings or selected by the Architect.
- D. Materials:

1. Glass: ASTM C 1048, Kind FT (fully tempered) as indicated, Condition C (spandrel glass, one surface ceramic coated), ultra-clear (low iron) annealed vision glass conforming to ASTM C 1036, Type I (transparent flat glass), Class 1 (clear), Quality Q3 (select glazing applications).

2.3 ACCESSORIES

- A. Tray: Provide manufacturer's standard mechanically-attached blade type trays.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 1. Install markerboards using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed markerboards must be warrantable. Do not install, correct, or replace markerboards in a manner that results in any warranty or guarantee becoming void.

- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach markerboards to supporting construction.
- C. Installation Tolerances: Install markerboards to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible markerboard surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed markerboards in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed markerboards unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed markerboards as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 11 23 – TACK BOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tack boards.
 - 2. Fabric facings.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the tack board manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples:
 - a. Submit at least 8-inch square representative samples of each tack board color, finish, and variety.
 - b. Submit at least 8-inch long representative samples of each tack board trim type, color, finish, and variety.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Submit manufacturer-prepared published instructions for proper installation of furnished tack boards.
 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for tack board maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
1. Tack boards must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.

2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective tack boards with undamaged new tack boards that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.

2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
3. Preference is given to product inventoried to at least 0.01% (100 ppm).
4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
5. Preference is given to Declare labels designated as Red List Free.

D. Low-Emitting Materials criteria:

1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. LAMVIN Inc.
 2. Claridge Products and Equipment, Inc.

2.3 TACK BOARDS

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.4 FABRIC FACING

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.5 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install tack boards using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed tack boards must be warrantable. Do not install, correct, or replace tack boards in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach tack boards to supporting construction.
- C. Installation Tolerances: Install tack boards to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible tack board surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed tack boards in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed tack boards unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed tack boards as work surfaces.

- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 14 00 -SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior signs.
2. Exterior signs.
3. Accessible parking signage.
4. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13 for sustainable design requirements.
 - a. Attachment: LEED Product Data Submittal Cover Sheet.
2. Section 05 50 00 for steel sheet, plate and sections.
3. Section 08 81 00 for glass.
4. Section 09 91 00 for paint.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the sign material manufacturer, unless otherwise indicated.
2. Fabricator: Means the sign fabricator, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
3. Samples: Submit at least 8-inch square representative samples of each sign color, finish, and variety.

- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished signs.
 - 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Signs must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
- A. Regulatory Requirements:
 - 1. Chemical Signs and Labels: Provide Proposition 65 signage in conformance with California Code of Regulations (CCR), Title 27.
 - 2. Raised Characters: Raised characters must conform to the requirements of California Building Code Section 11B-703.2:

3. Depth: It must be 1/32-inch (0.8 mm) minimum above their background and must be sans serif uppercase and be duplicated in Braille.
4. Height: It must be 5/8-inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I". California Building Code Section 11B-703.2.5
5. Finish and Contrast: Characters and their background must have a non-glare finish. Character must contrast with their background with either light characters on a dark background or dark characters on a light background. California Building Code Section 11B-703.5.1
6. Proportions: It must be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" must be 15 percent maximum of the height of the character. California Building Code Sections 11B-703.2.4 and 11B-703.2.6
7. Character Spacing: Spacing between individual raised characters must conform to the requirements of California Building Code Section 11B-703.2.7 and 11B-703.2.8
8. Format: Text must be in a horizontal format. California Building Code Section 11B-703.2.9
9. Braille: It must be contracted (Grade 2) and must conform to the requirements of California Building Code Sections 11B-703.3 and 11B-703.4. Braille dots must have a domed or rounded shape and must conform to the requirements of California Building Code Table and Figure 11B-703.3.1.
10. Mounting Height: Tactile characters on signs must be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. California Building Code Section and Figure 11B-703.4.1
11. Mounting Location: A tactile sign must be located per California Building Code Section and Figure 11B-703.4.2 as follows:
 - a. alongside a single door at the latch side.
 - b. on the inactive leaf at double doors with one active leaf.
 - c. to the right of the right hand door at double doors with two active leaves.
 - d. on the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leaves.
 - e. so that a clear floor space of 18 inches by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
12. Visual characters must conform to the requirements of California Building Code Section 11B-703.5 and must be 40 inches minimum above finish floor or ground.
13. Pictograms must conform to the requirements of California Building Code Section 11B-703.6.
14. Symbols of accessibility must conform to the requirements of California Building Code Section 11B-703.7.
15. Variable message signs must conform to the requirements of California Building Code Section 11B-703.8.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective signs with undamaged new signs that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Low-Emitting Materials Criteria
 - 1. VOC content criteria
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 SIGN BACKING AND BASE MATERIALS

- A. Aluminum Sheet and Plate: ASTM B 209. Provide flat plate stock or extruded material (not rolled stock).
 - 1. Alloy and Temper: 5005-H32 for anodic finishing; 3003-H14 for painted or unfinished sheet.
 - 2. Minimum Thickness:
 - a. Heavy Duty Applications: At least 0.080-inch (USSG 12), unless otherwise indicated.
 - b. Medium Duty Applications: At least 0.063-inch (USSG 14), unless otherwise indicated.
 - c. Light Duty Applications: At least 0.040-inch (USSG 18), unless otherwise indicated.
 - 3. Finish: Provide non-glare finish.
- B. Acrylic Sheet:
 - 1. Description: PMMA conforming to ASTM D 4802, Category A-2 (continuous cast), Finish 1 (smooth or polished), Type UVT (UV transmitting).
 - 2. Product: Provide one of the following, or equal.
 - a. "Acrylite FF" manufactured by Evonik Cyro LLC.
 - b. "Plexiglas" manufactured by Degussa AG.
 - c. "Lucite" manufactured by Lucite international.
 - 3. Requisite Properties:
 - a. Minimum Thickness: At least 3mm (nominal 1/8-inch) thick, unless otherwise indicated.
 - b. Color: Colorless
 - c. Optics Type: Transparent.
- C. PET Glycol-Modified (PETG) Sheet:
 - 1. Description: impact resistant transparent extruded polyethleneterephthalate glycol (PETG) copolyester sheet.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Plaskolite, Inc.
 - b. PolyOne.
 - c. Primex Plastic.
 - 3. Product: "Spectar PETG" manufactured from Eastman Chemical Co.'s "Eastman Spectar14471" resin

2.3 LETTERING

- A. Material: Cast vinyl film material. Calendared vinyl film is prohibited.
- B. Color: Indicated on the Drawings or selected by the Architect.

- C. Font: Indicated on the Drawings or selected by the Architect.
- D. Copy: Indicated on the Drawings or selected by the Architect.

2.4 PHOTOPOLYMER PANEL SIGNS

- A. Description: Single-piece photopolymer panel permanent identification signs consisting of moisture resistant non-glare photopolymer bonded to sign base material.
- B. Manufacturer: Provide photopolymer products manufactured by Nova Polymers, Inc., or equal.
- C. Fabricators: Provide signs fabricated by one of the following, or equal.
 - 1. Neiman & Co.
 - 2. Signtech Inc.
- D. Materials:
 - 1. Photopolymer Layer: 0.040-inch acrylic photopolymer.
 - 2. Base Material:
 - a. Interior Locations: 0.120-inch phenolic base.
 - b. Exterior Locations: Exterior grade photopolymer applied to a 0.120-inch phenolic base.
- E. Requisite Properties:
 - 1. Overall Panel Thickness: Between 1/8- and 1/4-inch.
 - 2. Colors: Indicated on the Drawings or selected by the Architect.
 - 3. Finish: Furnish non-glare finish.
 - 4. Edge Condition: Square cut.
 - 5. Corner Condition: Square.
 - 6. Mounting: Indicated on the Drawings.
 - 7. Copy: Indicated on the Drawings or selected by the Architect.
 - a. Letter spacing must conform to standards shown and kerned optically to the acceptance of the Architect.
 - b. Lines of copy must be straight and parallel to the sign format, unless otherwise indicated.
 - c. Edges of letters, numbers, and symbols must be smooth and continuous, with straight and curved portions reproducing the original forms exactly, with corners sharp and true.
 - d. All forms must be free from ticks, line waiver, discontinuous curves, and other imperfections.
 - 8. Font: Indicated on the Drawings or selected by the Architect.

2.5 ACCESSIBLE PARKING SIGNAGE

A. Signs:

1. Products: Provide products manufactured by STOPSignsAndMore.com, or equal.
 - a. Van Accessible Parking Signage: "R99-C-MOD" California disabled parking van accessible combo signs with sun-weather-graffiti protection.
 - b. Other Accessible Parking Signage: "R99-C (CA)" California disabled parking signs with sun-weather-graffiti protection.
2. Requisite Properties:
 - a. Size: 12 by 24-inches.
 - b. Base Material: 0.063-inch thick (USSG 14) 5052-H32 aluminum bare sheet with PVC on one side and conforming to ASTM B 209.
3. Sign Material:
 - a. Description: Microprismatic reflective sheeting with pressure-sensitive adhesive backing conforming to ASTM D 4956 Type I requirements, with Class-1 adhesive.
 - b. Products: "Engineer Grade Prismatic Reflective Sheeting Series 3430" manufactured by 3M, or equal.
 - c. Protective Film: "Premium Protective Overlay Film Series 1160" manufactured by 3M, or equal.
4. Corner Condition: Radiused.
5. Mounting: Furnish with holes drilled at the top and bottom centers.

B. Sign Posts:

1. Description: 52-inch high bollard/8-foot high signpost assembly that springs back into place after being hit by a vehicle.
2. Product: "Flexible Bollard Signpost Systems - Handicapped Parking" manufactured by Emedco, or equal.
3. Requisite Properties: Provide blue bollard with reflective white tape, without sign.

2.6 INSTALLATION MATERIALS

- A. Fasteners: Non-removable mechanical fasteners and anchors suitable for secure attachment to substrate and placed through predrilled holes as recommended in writing by the sign manufacturer.
 1. Exposed Fasteners: Exposed fasteners are permitted only where specifically stated in the drawings and must be stainless steel painted or finished to match adjacent surfaces, unless otherwise indicated.
 2. Concealed Fasteners: Fabricate from metals that are not corrosive to the sign material and mounting surface.
- B. Foam Tape: Black tape, .0125" used in conjunction with silicone adhesive for installation of wall mounted signs as manufactured by 3M, Arlon or equal
- C. Adhesive: "732 Multi-Purpose Sealant Clear" manufactured by Dow Corning Corp., or equal.

2.7 ACCESSORIES

- A. Plastic Cement: "WELD-ON 4" manufactured by IPC Corp., or equal.
- B. Laminating Tape: "VHB Tape" manufactured by 3M, or equal.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install signs using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed signs must be warrantable. Do not install, correct, or replace signs in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach signs to supporting construction.

- C. Installation Tolerances: Install signs to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible sign surfaces in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed signs in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything on or adjacent to or against installed signs unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed signs as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 14 13 – REGULATORY SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Restroom doors signs.
 - 2. Egress stairway door signs.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the sign material manufacturer, unless otherwise indicated.
 - 2. Fabricator: Means the sign fabricator, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples: Submit two (2) 8-inch square representative samples of each sign color, finish, and variety.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished signs.

2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Signs must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

A. Regulatory Requirements:

1. Chemical Signs and Labels: Provide Proposition 65 signage in conformance with California Code of Regulations (CCR), Title 27.
2. Raised Characters: Raised characters must conform to the requirements of California Building Code Section 11B-703.2:
3. Depth: It must be 1/32-inch (0.8 mm) minimum above their background and must be sans serif uppercase and be duplicated in Braille.
4. Height: It must be 5/8-inch (15.9 mm) minimum and 2 inches (51 mm) maximum based on the height of the uppercase letter "I". California Building Code Section 11B-703.2.5

5. Finish and Contrast: Characters and their background must have a non-glare finish. Character must contrast with their background with either light characters on a dark background or dark characters on a light background. California Building Code Section 11B-703.5.1
6. Proportions: It must be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase letter "I". Stroke thickness of the uppercase letter "I" must be 15 percent maximum of the height of the character. California Building Code Sections 11B-703.2.4 and 11B-703.2.6
7. Character Spacing: Spacing between individual raised characters must conform to the requirements of California Building Code Section 11B-703.2.7 and 11B-703.2.8
8. Format: Text must be in a horizontal format. California Building Code Section 11B-703.2.9
9. Braille: It must be contracted (Grade 2) and must conform to the requirements of California Building Code Sections 11B-703.3 and 11B-703.4. Braille dots must have a domed or rounded shape and must conform to the requirements of California Building Code Table and Figure 11B-703.3.1.
10. Mounting Height: Tactile characters on signs must be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. California Building Code Section and Figure 11B-703.4.1
11. Mounting Location: A tactile sign must be located per California Building Code Section and Figure 11B-703.4.2 as follows:
 - a. alongside a single door at the latch side.
 - b. on the inactive leaf at double doors with one active leaf.
 - c. to the right of the right hand door at double doors with two active leaves.
 - d. on the nearest adjacent wall where there is no wall space at the latch side of a single door or at the right side of double doors with two active leaves.
 - e. so that a clear floor space of 18 inches by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
12. Visual characters must conform to the requirements of California Building Code Section 11B-703.5 and must be 40 inches minimum above finish floor or ground.
13. Pictograms must conform to the requirements of California Building Code Section 11B-703.6.
14. Symbols of accessibility must conform to the requirements of California Building Code Section 11B-703.7.
15. Variable message signs must conform to the requirements of California Building Code Section 11B-703.8.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective signs with undamaged new signs that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
1. 018113 Sustainable Design Requirements
- B. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 PHOTOPOLYMER PANEL SIGNS

- A. Description: Single-piece photopolymer panel permanent identification signs consisting of moisture resistant non-glare photopolymer bonded to sign base material.

- B. Manufacturer: Provide photopolymer products manufactured by Nova Polymers, Inc., or equal.
- C. Fabricators: Provide signs fabricated by one of the following, or equal.
 - 1. Neiman & Co.
 - 2. Signtech Inc.
 - 3. APCO Graphics, Inc.
- D. Materials:
 - 1. Photopolymer Layer: 0.040-inch acrylic photopolymer.
 - 2. Base Material:
 - a. Interior Locations: 0.120-inch phenolic base.
 - b. Exterior Locations: Exterior grade photopolymer applied to a 0.120-inch phenolic base.
- E. Requisite Properties:
 - 1. Overall Panel Thickness: Between 1/8- and 1/4-inch.
 - 2. Colors: Indicated on the Drawings.
 - 3. Finish: Furnish non-glare finish.
 - 4. Edge Condition: Square cut.
 - 5. Corner Condition: Square.
 - 6. Mounting: Indicated on the Drawings.
 - 7. Copy: Indicated on the Drawings.
 - a. Letter spacing must conform to standards shown and kerned optically to the acceptance of the Architect.
 - b. Lines of copy must be straight and parallel to the sign format, unless otherwise indicated.
 - c. Edges of letters, numbers, and symbols must be smooth and continuous, with straight and curved portions reproducing the original forms exactly, with corners sharp and true.
 - d. All forms must be free from ticks, line waiver, discontinuous curves, and other imperfections.
 - 8. Font: Indicated on the Drawings.

2.3 INSTALLATION MATERIALS

- A. Fasteners: Non-removable mechanical fasteners and anchors suitable for secure attachment to substrate and placed through predrilled holes as recommended in writing by the sign manufacturer.
 - 1. Exposed Fasteners: Exposed fasteners are permitted only where specifically stated in the drawings and must be stainless steel painted or finished to match adjacent surfaces, unless otherwise indicated.
 - 2. Concealed Fasteners: Fabricate from metals that are not corrosive to the sign material and mounting surface.

- B. Tape: "VHB Tape" manufactured by 3M, or equal.
- C. Adhesive: "732 Multi-Purpose Sealant Clear" manufactured by Dow Corning Corp., or equal.

2.4 ACCESSORIES

- A. Plastic Cement: "WELD-ON 4" manufactured by IPC Corp., or equal.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install signs using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed signs must be warrantable. Do not install, correct, or replace signs in a manner that results in any warranty or guarantee becoming void.

- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach signs to supporting construction.
- C. Installation Tolerances: Install signs to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible sign surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed signs in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed signs unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed signs as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 14 19 – DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Dimensional characters used for building signage.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the signage fabricator, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
2. Samples: Submit two (2) 8-inch square representative samples of each signage material, finish, and variety.

B. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.

- b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective signage with undamaged new signage that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Low-Emitting Materials criteria:
 - 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits

- 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 DIMENSIONAL CHARACTERS

- A. Description: Provide cutout characters with square-cut, smooth, eased edges.
- B. Requisite Properties:
 1. Material: Indicated on the Drawings or selected by the Architect.
 2. Typeface: Indicated on the Drawings.
 3. Thickness: At least 1/4-inch thick.
 4. Height and Depth: Indicated on the Drawings.
 5. Aluminum Finish: Furnish non-glare finish.
 6. Mounting: Projected with concealed non-corroding studs for substrates encountered.
 7. Spacing and Text/Message: Indicated on the Drawings.

2.3 MATERIALS

- A. Aluminum Plate: ASTM B 209. Provide flat plate stock or extruded material. Rolled stock is prohibited. Furnish alloy and temper 5005-H32 for anodic finishing; 3003-H14 for painted or unfinished material.

2.4 FINISHES

- A. Comply with National Association of Architectural Metal Manufacturers publication AMP 500, *"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. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 INSTALLATION MATERIALS

- A. Fasteners: Non-removable mechanical fasteners and anchors suitable for secure attachment to substrate and placed through predrilled holes as recommended in writing by the signage manufacturer.
 1. Exposed Fasteners: Exposed fasteners are permitted only where specifically stated in the drawings and must be stainless steel painted or finished to match adjacent surfaces, unless otherwise indicated.

2. Concealed Fasteners: Fabricate from metals that are not corrosive to the signage material and mounting surface.

B. Tape: "VHB Tape" high-strength, double-sided, acrylic foam tape by 3M, or equal.

C. Adhesive: "732 Multi-Purpose Sealant Clear" by Dow Corning Corp., or equal.

2.6 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
1. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 2. Installed signage must be warrantable. Do not install, correct, or replace signage in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach signage to supporting construction.

- C. Installation Tolerances: Install signage to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible signage in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed signage in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything on or adjacent to or against installed signage unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed signage as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 21 13 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid plastic toilet compartments.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the toilet compartment manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing toilet compartment layout, materials, construction, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
3. Samples: Submit at least 8-inch square representative samples of each toilet compartment color, finish, and variety.

- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished toilet compartments.
 - 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Closeout Submittals: Submit copies of manufacturer's instructions and other requirements and recommendations for toilet compartment maintenance, cleaning, and repair to the Architect as a condition of project closeout.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 - 1. Toilet compartments must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 - 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

- A. Regulatory Requirements:

1. Wheelchair accessible compartments must conform to the requirements of California Building Code Section 11B-604.8.1.
2. Toe clearance for at least one side partition of a wheelchair accessible compartment must conform to the requirements of California Building Code Section and Figure 11B-604.8.1.4. It must be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members. It must be 12 inches high minimum above the finish floor for children's use. Partition components at toe clearances must be smooth without sharp edges or abrasive surfaces. Toe clearance at the side partition is not required in a compartment greater than 66 inches wide.
3. Ambulatory accessible compartments must be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more fixtures. Such compartments must be provided in the same quantity as wheelchair accessible compartments per California Building Code Section 11B-213.3.1 and must conform to the requirements of California Building Code Section 11B-604.8.2.
4. Door and door hardware for accessible compartments must be self-closing and must conform to the requirements of California Building Code Section 11B-404 except that if the approach is to the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction must be 44 inches minimum. California Building Code Figure 11B-604.8.2.
5. A door pull complying with California Building Code Section 11B-404.2.7 must be placed on both sides of the accessible compartment door near the latch.
6. Toilet compartment doors must not swing into the clear floor space or clearance required for any fixture or into the minimum compartment area required for ambulatory accessible compartments.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective toilet compartments with undamaged new toilet compartments that do not exhibit deterioration, damage, or defects.

- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- C. Low-Emitting Materials criteria:
 - 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Bradley Corp.
 - 2. Hadrian Inc.
 - 3. Scranton Products.

2.3 SOLID PLASTIC TOILET COMPARTMENTS

- A. Description: Gap-free solid high-density polyethylene (HDPE) partitions and screens.
- B. Products: "Solid Plastic Toilet Partitions" manufactured by Hadrian Inc., or equal.
- C. Requisite Properties:
 - 1. Partition Style: Overhead-braced.
 - 2. Urinal Screen Style: Wall-mounted.
 - 3. Doors, Panels, Pilasters, and Screen Thickness: One-inch thick, 1/4-inch radiused rounded edges.
 - 4. Headrail: Extruded anodized aluminum with satin finish.
 - 5. Color: Indicated on the Drawings.
 - 6. Surface Texture: Indicated on the Drawings or Selected by the Architect.

2.4 HARDWARE

- A. General:
 - 1. Provide stainless steel 18-8, Type 304 No. 4 finish hardware. Chrome-plated brass, chrome-plated zinc alloy and aluminum hardware are prohibited.
 - 2. Provide manufacturer's standard vandal-resistant option for all hardware.
- B. Hinges: Provide stainless steel wraparound gravity hinges, through-bolted to pilasters, and that allow for fully-adjustable door closing position.
- C. Latches: Provide stainless steel surface-mounted slide latch and keeper.
- D. Door Pull: Provide stainless steel pulls at out-swinging doors mounted in conformance with the accessibility requirements of the authorities having jurisdiction. Provide pulls at both sides of compartment doors indicated to be accessible.
- E. Coat Hook/Bumper: Provide manufacturer's standard combination hook and rubber-tipped bumper, mounted on the water closet side of each compartment door, and sized to prevent door from hitting compartment-mounted accessories.

2.5 ACCESSORIES

- A. Heat-Sink Strips: Provide aluminum heat-sink strips fastened to exposed bottom edges of doors and panels with vandal-proof fasteners.
- B. Brackets: Provide stainless steel continuous brackets.
- C. Pilaster Shoes: Provide 3-inch high stainless steel shoes secured by concealed fasteners.

- D. Mounting Brackets: Stainless steel, mounted inside compartment. Mounting brackets exposed on the exterior of the compartment are prohibited. Wall mounted urinal screen brackets must be at least 0.1250-inch thick (USSG 11) double thickness.
- E. Fasteners: Provide tamper-resistant stainless steel fasteners for component connections, for attaching exposed hardware and for fastening compartments to walls.
- F. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- G. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install toilet compartments using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction

3. Installed toilet compartments must be warrantable. Do not install, correct, or replace toilet compartments in a manner that results in any warranty or guarantee becoming void.

B. Special Techniques:

1. Set pilasters with anchorages having at least 2-inch penetration into structural floor, unless otherwise recommended by partition manufacturer.
 - a. Level, plumb, and tighten installation with devices furnished.
 - b. Hang doors and adjust so that tops of doors are level with tops of pilasters when doors are in closed position.
2. Install hardware as recommended by manufacturer. Conceal evidence of drilling in finished work.

C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach toilet compartments to supporting construction.

D. Installation Tolerances: Install toilet compartments to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 ADJUSTING

- A. Verify smooth and quiet toilet compartment door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible toilet compartment surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed toilet compartments in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed toilet compartments unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed toilet compartments as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 26 13 – CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Corner guards.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the corner guard manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples: Submit at least 6-inch long representative samples of each corner guard type, color, finish, and variety.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review; responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished corner guard.

2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Corner guards must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Surface-Burning Characteristics: Provide corner guards having a maximum FSI Value of 25 or less and a maximum SDI Value of less than 450 (Class A), when tested in conformance with ASTM E 84.

1.5 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.

2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective items with undamaged new items that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- C. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.

- 1) Refer to Section 018113 for VOC content limits
- 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 1. CS Group, Inc.
 2. InPro Corp.
 3. Koroseal Interior Products, Inc.
 4. Protek Systems, Inc.

2.3 VINYL CORNER GUARDS

- A. Description: Vinyl corner guards
- B. Product: "Tape-on Corner Guards" manufactured by InPro Corp., or equal.
- C. Requisite properties:
 1. Profile: 90-degree sharp profile.
 2. Wing Size: 1.5-inch by 1.5-inch.
 3. Material: Rigid vinyl.
 4. Thickness: At least 0.080-inch thick.
 5. Length: 48-inches high.
 6. Attachment: Surface mounted.

2.4 ACCESSORIES

- A. Mounting and Material Adhesives: Structural-grade silicone or epoxy adhesives of type recommended or accepted by manufacturer for conditions of use.
- B. Sealant:

1. Description: Clear or white, medium or high modulus, mildew-resistant silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 25, Use NT, A or O sealant, as applicable.
 2. Products: "786" manufactured by Dow Corning Corp., or "Sanitary SCS 1700" manufactured by Momentive Performance Materials, Inc., or equal.
- C. Solvent: Supplied, required, recommended, or accepted by the manufacturer to clean substrates to ensure adhesion of adhesives and sealants.
- D. Cleaner: Supplied, required, recommended, or accepted by the manufacturer for use on installed corner guard and actual in-service conditions applicable to the project. Cleaners must remove stains, dirt, and residue without damaging or altering corner guard surfaces.
- E. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
1. Install corner guards using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed corner guards must be warrantable. Do not install, correct, or replace corner guards in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach corner guards to supporting construction.
- C. Installation Tolerances: Install corner guards to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible corner guard surfaces in a manner that does not result in any warranty or guarantee becoming void.
1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.

- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed corner guards in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed corner guards unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed corner guards as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 28 13 – COMMERCIAL TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Commercial toilet accessories.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the toilet accessory manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Submit manufacturer-prepared published instructions for proper installation of furnished toilet accessories.
2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.

3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Toilet accessories must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Elements of sanitary facilities must be mounted at locations in conformance with California Building Code Sections 11B-602 through 11B-612.
2. Grab bars in toilet facilities and bathing facilities must conform to the requirements of California Building Code Section 11B-609. Grab bars and any wall or other surfaces adjacent to grab bars must be free of sharp or abrasive elements and must have rounded edges. The space around the grab bars must be as follows:
 - a. 1-1/2-inch between the grab bar and the wall.
 - b. 1-1/2-inch minimum between the grab bar and projecting objects below and at the ends.
 - c. 12 inches minimum between the grab bar and projecting objects above.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective toilet accessories with undamaged new toilet accessories that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley Corp.
 - 3. Sloan Valve Company.

2.3 COMMERCIAL TOILET ACCESSORIES

- A. Products: Indicated on the Drawings, or equal.
- B. Materials:
 - 1. Stainless-Steel Sheet: ASTM A 666 (annealed and tempered) Type 304 tension leveled to a flatness of 5 I-units or less.
 - 2. Mirrored Glass: ASTM C 1503, Q-1 Mirror Select Quality.

2.4 ACCESSORIES

- A. Pipe Guards:
 - 1. Description: Insulating antimicrobial, molded plastic, white pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Manufacturers: Provide products manufactured by one of the following, or equal.
 - a. Plumberex Specialty Products, Inc.
 - b. IPS Corp.
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that

might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.

C. Evaluation and Assessment:

1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

A. General Requirements:

1. Install toilet accessories using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed toilet accessories must be warrantable. Do not install, correct, or replace toilet accessories in a manner that results in any warranty or guarantee becoming void.

B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach toilet accessories to supporting construction.

C. Installation Tolerances: Install toilet accessories to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include

1. written descriptions of non-conforming, damaged, and defective work;
2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.

- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible toilet accessory surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed toilet accessories in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed toilet accessories unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed toilet accessories as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 10 44 00 – FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire extinguishers.
2. Fire extinguisher cabinets.
3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the fire protection specialty manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate size of fire extinguisher cabinets to ensure specified fire extinguishers and capacities are accommodated.
2. Coordinate sizes and locations of fire extinguisher cabinets with wall depths.
3. Final location of fire extinguisher cabinets is subject to fire marshal approval.
 - a. Verify cabinet locations with both the fire marshal and the Architect during the framing stage of the project.
 - b. Positioning of cabinets at locations other than where indicated are at no additional cost to the Owner.
4. Where extinguishers are not indicated, assume cabinets and extinguishers are located within 75 feet of any point in the building, or at a rate of one for each 3,000 square feet of building area, or portion thereof, whichever yields the greater number of fire extinguishers.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing fire extinguisher cabinet locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished fire protection specialties.
 - 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - 3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:

1. Fire protection specialties must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Regulatory Requirements:

1. Fire Extinguisher Standard: Fire extinguishers must conform to the requirements of California Code of Regulations Title 19 (Public Safety), Division 1 (State Fire Marshal), Chapter 3 (Fire Extinguishers).
2. Mounting Height: When installed within the cabinet, bracket-mounted extinguisher handles height must conform to the prescribed limits for an ADA-accessible front-approach reach.
3. UL Listing:
 - a. Provide UL-listed fire extinguishers bearing the UL listing mark for type, fire classification, and rating specified.
 - b. Provide cabinets with the same fire rating as wall in which they are installed.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective fire protection specialties with undamaged new fire protection specialties that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Activar Construction Products Group, Inc.
 - 2. Larsen's Manufacturing Co.
 - 3. Potter Roemer Fire Protection Equipment.

2.3 FIRE EXTINGUISHERS

- A. Description: UL-listed, heavy duty, enameled steel cylinder, multi-purpose dry chemical fire extinguishers conforming to NFPA 10 requirements for portable extinguishers, and bearing the UL listing mark for type, fire classification, and rating specified.
- B. Products: "JL Industries Cosmic 10E" manufactured by Activar Construction Products Group, Inc., or equal.
- C. Requisite Properties:
 - 1. Capacity: 10 pounds.
 - 2. UL Rating: 4-A:80-B:C.
 - 3. Cylinder Diameter: Not more than 5-1/4 inches.
 - 4. Overall Height: Not more than 22 inches.

2.4 FIRE EXTINGUISHER CABINETS

- A. Description: Fire extinguisher cabinets conforming to ASTM E 814 when installed within fire-resistance rated wall assemblies. Cabinets must have the same fire-resistance rating as the wall in which they are installed.
- B. Stainless Steel Cabinets:
 - 1. Products: "JL Industries Cosmopolitan Series" manufactured by Activar Construction Products Group, Inc., or equal.
 - a. Square Trim Semi-Recessed Cabinets: "Model No. 1036V17" (non-locking) or "Model No. 8136W17" (locking).
 - b. Fire-Rated Cabinets: Provide model numbers with the "-FX2" suffix for fire rated tub option at fire-resistance rated construction.
 - 2. Requisite Properties:
 - a. Door Style: "Vertical Duo" with tempered safety glass.
 - b. Tub Size: 10-1/2 inches wide by 24 inches high by 6 inches deep.
 - c. Frame Size: 13-5/8 inches wide by 27-1/8 inches.
 - d. Non-Rated Cabinet Rough Opening Size: 11-1/2 inches wide by 25 inches high by 6-1/8 inches deep.
 - e. Fire-Rated Cabinet Rough Opening Size: 12-13/16 inches wide by 26-5/16 inches high by 6-11/16 inches deep.
 - f. Finish: Painted to match adjacent wall surface.
 - g. Door Hardware: Standard pull handle with "Saf-T-Lok", or equal where indicated as locked.
- C. Accessories:
 - 1. Mounting Brackets:
 - a. Provide manufacturer's standard brackets sized as required for specified extinguishers; manufacturer's standard finish.
 - b. Provide brackets for all extinguishers, including those mounted in cabinets. Provide manufacturer's standard J-hook wall brackets for extinguishers installed within fire extinguisher cabinets.
 - 2. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.

- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install fire protection specialties using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed fire protection specialties must be warrantable. Do not install, correct, or replace fire protection specialties in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach fire protection specialties to supporting construction.
- C. Installation Tolerances: Install fire protection specialties to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 ADJUSTING

- A. Verify smooth and quiet fire extinguisher cabinet door and hardware operation.
- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 CLEANING

- A. Cleaning Work: Clean all visible fire extinguisher cabinetsurfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.6 PROTECTION

- A. Protect installed fire protection specialties in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed fire protection specialties unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed fire protection specialties as work surfaces.

- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 107500 - FLAGPOLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum Flagpoles.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete base and foundation construction.
- B. Section 312323 - Fill: Sand to fill foundation tube sleeve.

1.3 REFERENCE STANDARDS

- A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2012.
- D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, configurations, and flags.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flagpoles:

1. Concord Industries, Inc: www.concordamericanflagpole.com/#sle.
2. Substitutions: Not permitted.

2.2 FLAGPOLES

A. Flagpoles: Titan Series Designed in accordance with NAAMM FP 1001

1. Model: #IWW25C61-ACL
2. Material: Aluminum.
3. Design: Cone tapered.
4. Mounting: Ground mounted type.
5. Nominal Wall Thickness: .156 inches.
6. Nominal Height: 25 ft; measured from nominal ground elevation.
7. Halyard: Interior type with flush mounted hinge door.

B. Performance Requirements:

1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 85 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.3 POLE MATERIALS

- A. Aluminum: ASTM B241/B241M , 6063 alloy , T6 temper.

2.4 ACCESSORIES

- A. Finial Ball: BAL-0612-ACL; Aluminum, 6 inch diameter.
- B. Truck Assembly: TRK-960-CLR; Cast aluminum; internal revolving, stainless steel ball bearings, non-fouling.
- C. Flag: Country, State, & City design, 5 ft by 8 ft size, nylon fabric, brass grommets, hemmed edges.
1. Quantity: Three (3) total; One(1) each type
- D. Internal Winch Box: Flush Aluminum keyed access door, with continuous piano hinge, manually operated winch with positive locking at any position and removable winch handle.
- E. Halyard: 5/16 inch diameter polypropylene, braided, white.
1. Flag Sections; Two (2)

2.5 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of 66 inches as indicated.

- B. Pole Base Attachment: Flush; aluminum base with base cover.
- C. Lighting Ground Rod: copper rod length per plan, 3/4 inch diameter. 12 inch extension into soil minimum

2.6 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
- C. Aluminum: Anodized Clear.
- D. Finial: Spun finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.

3.2 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.3 INSTALLATION

- A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.
- B. Fill foundation tube sleeve with sand specified in Section 312323 and compact.
- C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch.

3.5 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION 107500

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SECTION 10 99 00 – BUILDING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass enclosed display case doors.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the building specialty manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings:
 - a. Submit dimensioned plans and elevations drawn to scale and showing building specialties layout, materials, joints, edge conditions, and finishes. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing building specialties attachment to supporting construction; and other conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project. Cross-reference details to plans and elevations.

- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished building specialties.
 - a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 - 1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for building specialties maintenance, cleaning, and repair.
- D. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Building specialties must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - 1. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - 2. Items provided for each different installation must be obtained from the same source and manufacturer.

1.5 HANDLING

- A. Receiving and Inspection: Inspect all deliveries for deteriorated, damaged, and defective items. Reject items that
 - 1. are not packaged in a manner that prevents damage;
 - 2. are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements; or
 - 3. exhibit deterioration and damage; or that have damaged or open containers.
- B. Unloading: With minimum handling, unload and store only inspected and accepted items.
- C. Storage: Store unloaded items as shipped, upright in their original containers, and in conformance with manufacturer's instructions and other requirements and recommendations for storage.
 - 1. Store items indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas; where "wet work" within storage areas (e.g., concrete, cast underlayment, mortaring, grouting, plastering, gypsum board finishing, etc.) is complete and cured or dried to a condition of equilibrium.
 - 2. Prevent stored items from contacting the floor or ground, from soiling and staining, and from deterioration and damage.
- D. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage.
- E. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- F. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the

LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 GLASS ENCLOSED DISPLAY CASE DOORS

- A. Products: "1301-SM Series Display Case Door System" manufactured by C.R. Laurence Co., Inc., or equal.
- B. Requisite properties:
 1. Size: Indicated on the Drawings.
 2. Finish: Bronze clad.
 3. Glazing Thickness: 3/8 inch (10 mm).
 4. Glazing: Provide flat, fully tempered glass or annealed laminated glass in thickness indicated for doors and sidelites.
 - a. Tempered glass components that comply with ANSI Z97.1 and testing requirements of CPSC 16 CFR 1201 Category II. ASTM 1048.
 - b. Laminated annealed glass that comply with ASTM C1172, ANSI Z97.1 and testing requirements of CPSC 16 CFR 1201 Category II.
- C. Hardware:
 1. Rail Configuration: Full Width at top and bottom of doors as indicated on drawings.
 2. 1-1/4-inch (31.8 mm) square in black aluminum; 1-3/8-inch (35 mm) square when clad.
 3. Center pivots to be AP-150 at top; BP-150 at bottom.
 4. Lock to be #7150 lever type cam lock in top or bottom rail or both rails (Specify).
 5. Accessory Fittings: Provide manufacturer's standard accessories of the type indicated. Comply with requirements indicated for kind and form metal and finish of door fittings.
 - a. Overhead door stop: Roller Catch/Stop to be #593 with strike plate in top rail.
 - b. Sidelite Systems: Provide sidelite systems with matching glass, metal rail, and finish of door.
 6. Anchors and Fasteners: Manufacturer's standard concealed anchors and fasteners. Do not use exposed fasteners.

2.3 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

- B. Other Accessories: Provide other accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations, and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install building specialties using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 - 4. Installed building specialties must be warrantable. Do not install, correct, or replace building specialties in a manner that results in any specified or other warranty or guarantee becoming void.
- B. Interface with Other Work: Provide materials, components, and accessories normally furnished or necessary to securely attach building specialties to supporting construction.
- C. Installation Tolerances: Install building specialties to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch and from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work:
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Clean all visible building specialties surfaces in a manner that does not result in any specified or other warranty or guarantee becoming void. Clean spills, stains, soiling, overspray, and fallout from adjacent surfaces.
 - 4. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 5. Arrange and pay costs for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed building specialties in place from soiling, deterioration, and damage until Substantial Completion.

- B. Do not store anything on or adjacent to or against installed building specialties unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed building specialties as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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DIVISION 11

EQUIPMENT

SECTION 11 31 10 – KITCHENETTE APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Kitchenette appliances.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the appliance manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)
- B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Submit manufacturer-prepared published instructions for proper installation of furnished appliances.
 - 2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.

3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
- C. Closeout Submittals: Submit the following to the Architect as a condition of project closeout.
 1. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.

1.4 QUALITY ASSURANCE

- A. Source Limitations:
 1. Appliances must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
 2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.
 3. All appliances must be Energy-Star Rated.
 4. Equal products and substitutions must match dimensions of appliances indicated, and be submitted for Architect's approval with documentation evidencing that proposed appliance dimensions are not larger than those indicated.

1.5 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective appliances with undamaged new appliances that do not exhibit deterioration, damage, or defects.

- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.6 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. LG Electronics.
 - 2. GE Appliances.
 - 3. KitchenAid.

2.2 KITCHENETTE APPLIANCES

- A. Refrigerator:
 - 1. Product: "LFCC22426S" manufactured by LG Electronics, or equal.
 - 2. Requisite Properties:
 - a. Height: 68.5 inches.
 - b. Width: 35.75 inches.
 - c. Depth: 43.5 inches.
 - d. Capacity: 23 cubic feet.
 - e. Finish: Stainless steel.
 - f. Icemaker.

2.3 ACCESSORIES

- A. Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install appliances using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, and in alignment with adjacent construction
 - 3. Installed appliances must be warrantable. Do not install, correct, or replace appliances in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach appliances to supporting construction and to safely connect facility services.
- C. Installation Tolerances: Install appliances to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible appliance surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.

3.5 PROTECTION

- A. Protect installed appliances in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed appliances unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed appliances as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 11 51 00 – LIBRARY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Book depositories.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the library equipment manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

1.4 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective library equipment with undamaged new library equipment that does not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
 - 1. Borroughs Corporation.
 - 2. Kingsley Equipment.
 - 3. Montel Inc.
 - 4. MJ Industries.
 - 5. Spacesaver Corporation.

2.2 OUTDOOR BOOK DEPOSITORIES

- A. Products: "60 C-Series Outdoor Depositories" manufactured by Kingsley Equipment, or equal.
- B. Requisite Properties:
 - 1. Size: 38-inches wide by 50-3/16-inches deep by 53-5/8-inches high.
 - 2. Material: 12-gage aircraft grade aluminum.
 - 3. Finish: White.
- C. Accessories:
 - 1. Transport Cart: "30-9060 High-Capacity Cart" manufactured by Kingsley Equipment, or equal.
 - 2. Braille Tags: "BOOK DROP (#99-8100)" manufactured by Kingsley Equipment, or equal.
 - 3. MagnaClose Kit: "#09-9800" manufactured by Kingsley Equipment, or equal.
 - 4. Insulation Kit: "#09-0160"
 - 5. Graphics: Provide custom wording "LIBRARY MATERIALS ONLY. NO DONATIONS".

2.3 THRU-WALL BOOK DEPOSITORIES

- A. Products: "ValuStar Thru-Wall Depositories" manufactured by Kingsley Equipment, or equal.
- B. Requisite Properties:
 - 1. Size: 18.08-inches wide by 13.8-inches deep by 12.23-inches high.
 - 2. Material: Aircraft grade aluminum.

2.4 ACCESSORIES

- A. Supports: Provide back-to-wall and back-to-back supports for shelving stability supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:

1. Install library equipment using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed library equipment must be warrantable. Do not install, correct, or replace library equipment in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach library equipment to supporting construction.
- C. Installation Tolerances: Install library equipment to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible library equipment surfaces in a manner that does not result in any warranty or guarantee becoming void.
1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.

3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed library equipment in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed library equipment unless equipment is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed library equipment as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 11 51 23 – LIBRARY STACK SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal library shelving.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the library equipment manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.

1.4 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 - 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 - 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 - 3. Unload and store only inspected and accepted items.

- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective library equipment with undamaged new library equipment that does not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 METAL LIBRARY SHELVING

- A. Products: "Estey Cantilever Library Shelving Systems" manufactured by Tennsco Inc., or equal.
- B. Requisite Properties:
 - 1. Size: Indicated on the Drawings.
 - 2. Overall Size: Indicated on the Drawings.
 - 3. Usage Capability: Indicated on the Drawings.
 - 4. Shelf Quantity: Indicated on the Drawings.
 - 5. Finish: Manufacturer's standard powder coat finish.
 - 6. Color: Indicated on the Drawings or selected by the Architect.
- C. Components:
 - 1. Upright Columns of the Welded Frame: Form of not less than 14 gage steel into a channel shape with 3/4-inch stiffening.
 - 2. Top Spreaders of the Welded Frame: Minimum 14 gage steel closed tube measuring not less than one inch by 3 inch.

2.2 MATERIALS

- A. Steel: Conform to ASTM A 1008/A1008M, cold rolled double annealed, fully pickled and free from scale and buckles.
- B. Plastic laminate: Selected by Architect or as indicated on drawings.

2.3 SYSTEM DESCRIPTION

- A. Shelving must be cantilever design manufactured in true unit construction. Each book stack section must be capable of removal as a modular unit from any range without disturbing adjacent units. Relocation and reuse of removed sections can be accomplished without requiring additional parts.
- B. The uprights and cross member supports make up the fully welded frame construction. Uprights must be punched for bolting additional weld frame units into the book stack range. Shelving design must allow for either static or mobile installation. Starter/Adder and/or diagonal sway braced systems are not acceptable.
- C. Capacity: Each shelf must have a minimum clearance between end brackets of 35-13/32 inch. Unit widths must be 36 inches nominal overall. Units must be capable of supporting 50 pounds evenly distributed weight per linear foot of shelving, multiplied times the number of shelves per unit, without deflection considered excessive by industry standards.

2.4 ACCESSORIES

- A. Steel Book Supports: Form of 16-gage steel, one piece construction, 6 inches or 9 inches high, with a "T" shaped base 5-1/2 inches deep. The top and side faces must be flanged to a 1/4-inch radius.
 - 1. The underside of steel book support must receive a 1/32-inch-thick composition cork bracing.
 - 2. The underside of steel book support must receive a magnetic strip.
- B. Canopy Brackets for Wood Tops: Integral bracket supports for wood/HPL canopy tops must be formed of 14-gage steel. Brackets must have 3 hooks at the rear to engage the column slots and permit easy adjustment of top with maximum possible protection against dislodgment. Brackets must be fastened to the top with galvanized steel angles.
- C. Supports: Provide supports for shelving stability supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- D. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- E. Integrated LED light: Precision laser cut and die formed galvanized steel mount box with precision laser cut and die formed aluminum sheet painted fascia, access covers, and reflectors, aluminum tube sleeves over all-thread steel tubin painted arms, LEDS 90+, dimmable programmable driver, extruded acrylic lens, and extruded aluminum round housing. To be provided by shelving manufacturer.
- F. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install library equipment using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed library equipment must be warrantable. Do not install, correct, or replace library equipment in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach library equipment to supporting construction.
- C. Installation Tolerances: Install library equipment to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.

- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible library equipment surfaces in a manner that does not result in any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed library equipment in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed library equipment unless equipment is protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed library equipment as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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DIVISION 12

FURNISHINGS

SECTION 12 05 16 – UPHOLSTERY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contract textiles.
 - 2. Cushion foam.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the fabric, foam, or accessory manufacturer, as the context admits, unless otherwise indicated.
 - 2. Fabricator: Means the cushion fabricator, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Samples: Submit at least 8-inch square representative samples of each textile color, finish, and variety.
- B. Sustainable Design Submittals:
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.

3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Fabrics and foam must conform to California Bureau of Home Furnishings Fire Retardant Code 117.
2. Fabrics must also conform to NFPA 260A/UFAC requirements for Class 1.

1.5 HANDLING

A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.

1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
3. Unload and store only inspected and accepted items.

B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.

C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.

D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective textiles with undamaged new textiles that do not exhibit deterioration, damage, or defects.

E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- ##### A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet

the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:

1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
 2. Extender Producer Responsibility Program:
 - a. For products in this section from manufacturer that participates in or is directly responsible for an extended producer responsibility program, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).

4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 CONTRACT TEXTILES

- A. Description: Contract textiles manufactured for upholstery, including seating, and casework.
- B. Manufacturer: Provide products manufactured by one of the following, or equal.
1. Carnegie Fabrics.
 2. Designtex.
 3. Guilford of Maine.
 4. Knoll Textiles.
 5. Luna Textiles.
 6. Maharam.
 7. Wolf-Gordon.
- C. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.3 CUSHION FOAM

- A. Description: Medium density polyurethane foam.
- B. Requisite Properties:
1. Thickness: Indicated on the Drawings or selected by the Architect.
 2. Minimum Density: At least 1.6 pounds per cubic foot.
 3. Minimum Indentation Force Deflection (IFD): At least 36 pounds, when tested in conformance with ASTM D 3574.

2.4 ACCESSORIES

- A. Batting: Mid-weight 100-percent bonded polyester.

- B. Adhesive: "513" manufactured by Camie-Campbell, Inc., or equal, fast-tack upholstery, foam, and fabric low VOC spray adhesive.
- C. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.5 FABRICATION

- A. Shop Fabrication: Fabricate work straight, and true to line, size, and shape; and square within allowable tolerances; and with accurate angles and surfaces, and crisp straight edges.
- B. Fabrication Tolerances: Fabricated items to have not more than a 1/8-inch difference in diagonal measurements.
- C. Stitching or seam technique is to be "Double Stitched" method attachments to laminate to be Velcro.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install textiles using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
3. Installed textiles must be warrantable. Do not install, correct, or replace textiles in a manner that results in any warranty or guarantee becoming void.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean upholstery in a manner that does not result in any warranty or guarantee becoming void.
 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed textiles in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on, adjacent to, or against installed textiles unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed textiles as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 12 24 13 – ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roller window shades.
 - 2. Shade operation.
 - 3. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the window shade manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - 2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
 - 3. Samples: Submit at least 8-inch square representative samples of each window shade shadecloth color, finish, and variety.
- B. Informational Submittals: Submit the following for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
 - 1. Manufacturer's Instructions: Submit manufacturer-prepared published instructions for proper installation of furnished window shades.

- a. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
 - b. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.
2. Qualification Statements: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. Window shades must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

1.5 HANDLING

- A. Receiving and Inspection: Inspect all deliveries for deteriorated, damaged, and defective items. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.

- B. Unloading: With minimum handling, unload and store only inspected and accepted items.
- C. Storage: Store unloaded items as shipped, upright in their original packaging or containers, indoors within dry, well-ventilated, broom-cleaned, and partially- or permanently-enclosed storage areas.
- D. Damaged Item Replacement: Promptly remove and replace items that are deteriorated, damaged, or defective with undamaged new items that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.6 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products, components, and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 - 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 - 2. Preference is given to product-specific type III EPDs.
 - 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the

LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

- 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 MANUFACTURERS

- A. Manufacturers: Provide products manufactured by one of the following, or equal.
1. Draper, Inc.
 2. Lutron Electronics Co., Inc
 3. MechoShade Systems, Inc.

2.3 ROLLER WINDOW SHADES

- A. Products: Provide products manufactured by MechoShade Systems, Inc., or equal.

1. Shade Type 1: Motor operating sunscreen single roller shades and related motor control systems, mounting systems and accessories as indicated on Drawings.
 - a. Motor: iQ2-DC motor.
2. Shade Type 2: Bottom-up motor operating sunscreen single roller shades and related motor control systems, mounting systems and accessories as Feature Collections as indicated on Drawings.
 - a. Motor: iQ2-AC motor.

B. Requisite Properties:

1. Model: "ElectroShade with WhisperShade" manufactured by MechoShade Systems, Inc., or equal.
2. Sunscreen Shadecloth: "EcoSheer 6850 Series", or equal.
 - a. Size: Fabric width to match window mullion spacing.
 - b. Openness Factor: 1 percent open.
 - c. Color: "6855 Clay".
 - d. Pattern: Twill weave.
 - e. Bottom Hem: Straight.
 - f. Maximum Total Solar Energy Transmitted: (Ts) not more than 12.
 - g. Minimum Total Solar Energy Reflected: (Rs) at least 34.
 - h. Minimum Total Solar Energy Absorbed: (As) at least 55.
 - i. Minimum Visible Light Transmitted: (Tv) at least 11.
3. Mounting: Ceiling mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
4. Direction of Roll: Regular or reverse roll.
5. Operation: Motorized operation.

C. Performance Requirements:

1. Fire Resistance: Provide shade fabrics tested in conformance with NFPA 701, small scale Vertical Burn Test, and rated "PASS".
2. Toxicity: Provide shade fabrics tested in accordance with University of Pittsburgh Toxicity Protocol including LC50 analysis and toxicity characteristics.
3. Anti-Microbial: ASTM G 21 results indicating "No Growth"; ASTM G 22 results indicating minimum 0.197-inch "No Growth Contact Area".

2.4 COMPONENTS

- A. Side-Channel Assembly: "ShadeLoc System" is an extruded aluminum side and center channels consisting of mounting base, SnapLoc channel for capturing zippered edges of shade band, and rubber foam cushions to adjust for field conditions.
- B. Rollers: Either electro-galvanized or epoxy-primed steel, or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting

integral channel in tube for attaching shade material. Provide capacity for one roller shade band(s) per roller, unless otherwise indicated.

- C. Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia or headbox.
- D. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated; removable design for access.
- E. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.
- F. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
- G. Bottom Bar: Steel or extruded aluminum. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- H. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

2.5 SHADE OPERATION

- A. Motorized Shade Operation:
 - 1. Description: Factory-assembled motorized shade operation systems, listed and labeled as defined in NFPA 70, Article 100, and designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
 - 2. Control Equipment: Conforming to NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V AC or DC.
 - a. Line Voltage EDU (120 VAC).
 - b. Low Voltage EDU (24 VDC).
 - 3. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - 4. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure surface mounting. Rocker-style wall switch.

5. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.

B. Automatic Solar-Tracking Control System:

1. Description: Solar evaluation and sky modeling system utilizing ASHRAE Clear Sky algorithms incrementally adjust shade positions to maximize energy management, daylighting, occupant view, and occupant comfort; sky model calculated on weekly basis.
2. Product: "SunDialer" manufactured MechoShade Systems LLC., or equal.
3. System Capacity: Support up to 24 zones.
4. Communications Riser/Backbone: Provide manufacturer-approved communications riser/backbone and switches for communication at each floor or area.
 - a. Support dedicated Ethernet network, building or BMS Ethernet network, and RS485 riser/backbone implementation.
 - b. Sky condition, e.g., clear, cloudy, and overcast, as determined by microclimatic model based on input from roof-mounted solar radiometers.
5. Shade Positioning: Capable of aligning shades at up to 256 positions.
6. Override Capability: Capable of automatic override of shade positions for:
 - a. Dark or cloudy sky conditions, based on input from roof-mounted solar radiometers; shades go to predetermined position to maximize occupant view and available daylight.
 - b. Event scheduler: Configurable via control software; enable override of shade zones based on date range or absolute time range.
7. Capable of manual temporary override of shade positions using:
 - a. IQ Switch low-voltage wall controls.
8. Virtual Switch Override: Administrative settings allow for assignment of shade control restrictions for specific users.
9. Software user Interface: requires one SunDialer IP Interface unit per system.
10. Controllers: 12-zone controller with sensor ports for solar radiometer and IP interface; minimum of one required per project; requires internet connection for remote connectivity.
11. Accessories:
 - a. Solar Radiometers: For rooftop for measurement of sky conditions; provide quantity of two unless otherwise indicated; minimum of one controller with solar radiometers per project.

2.6 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install window shades using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Installed window shades must be warrantable. Do not install, correct, or replace window shades in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach window shades to supporting construction.
- C. Installation Tolerances: Install window shades to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 ADJUSTING

- A. Verify smooth and quiet window shade operation.

- B. Lubricate and adjust operating parts and hardware to function properly, free from warp, twist, binding, and distortion. Confirm latches and locks engage securely without forcing or binding.
- C. Replace items that do not operate freely in a safe and reliable manner.

3.4 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.5 PROTECTION

- A. Protect installed window shades in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed window shades unless they are protected from damage, as accepted in writing by the manufacturer's representative.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 12 36 63 – SOLID SURFACE MATERIAL COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surfacing countertops.
 - 2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.
- B. Related Requirements:
 - 1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

- A. Definitions:
 - 1. Manufacturer: Means the solid surfacing manufacturer, unless otherwise indicated.
 - 2. Fabricator: Means the countertop fabricator, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling:
 - 1. Acclimation: Allow sufficient time in the construction schedule to acclimate countertops to specified ambient conditions for between 72 hours and 6 weeks before installation begins, or until moisture content is not more than 8 percent, when measured with a moisture meter at specified ambient conditions.

1.4 SUBMITTALS

- A. Action Submittals: Submit the following for responsive action (formal review and approval).
 - 1. Product Data:
 - a. Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
 - b. Submit sample warranties with warranty periods, terms, conditions, exclusions, and remedies explicitly defined for each warranty, including clear warranty

period start dates. (e.g., date of manufacture, purchase, installation, Beneficial Occupancy, Substantial Completion, Final Completion, etc.)

2. Shop Drawings:
 - a. Submit dimensioned plans drawn to scale and showing countertop layout and types. Show locations, sizes, and extents of all items, accessories, and trim. Label manufactured items by product name.
 - b. Include project-specific dimensioned details drawn to scale showing profiles, shapes, joints, seams, and dimensions, including coves, miters, and corner conditions. Cross-reference details to plans.
 - c. Indicate method of attaching, fastening, joining, adhering, and anchoring to adjacent construction.
 3. Samples: Submit at least 8-inch square representative samples of each solid surfacing color, finish, and variety.
- B. Informational Submittals: Submit written descriptions confirming experience specified in QUALITY ASSURANCE article below for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).
- C. Closeout Submittals:
1. Maintenance Data: Submit copies of manufacturer's instructions and other requirements and recommendations for countertop maintenance, cleaning, and repair to the Architect as a condition of project closeout.
 2. Warranty Documentation: Submit final warranties signed by the manufacturer's representative with complete terms indicated for all warranties covering items furnished or installed under this specification section.
- D. Sustainable Design Submittals:
1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Source Limitations:

1. Countertops must be obtained through one source from the same manufacturer (to ensure compatibility, regulatory conformance, and a warrantable installation).
 - a. Certain items may be obtained from more than one manufacturer, but only when used for separate installations.
 - b. Items provided for each different installation must be obtained from the same source and manufacturer.
2. Provide secondary materials, components, accessories and other items from sources required, recommended, or accepted by the primary manufacturer for actual in-service conditions applicable to the project.

B. Quality Standards:

1. Fabrication Standard: Provide countertops conforming to Architectural Woodwork Institute/ Architectural Woodwork Manufacturer's Association of Canada/ Woodwork Institute publication "*Architectural Woodwork Standards*" requirements for each specified Grade.

C. Qualifications:

1. Manufacturer: Company or individuals must have at least 10 years' experience manufacturing countertop material installed on at least 200 previous projects similar to this project in size, material, design, and complexity.
2. Fabricator: Company or individuals must have at least 10 years' experience fabricating countertops installed on at least 100 previous projects similar to this project in size, material, design, and complexity
3. Installer: Company or individuals must have at least 5 years' experience installing countertops for at least 30 previous projects similar to this project in size, material, design, and complexity.
4. Supervisors: Individuals must have at least 7 years' experience installing countertops for at least 30 previous projects similar to this project in size, material, design, and complexity, including at least 2 years' supervisory experience directing and leading countertop installers.

1.6 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
1. Furnish adequate dunnage and bracing during storage.
 2. Prevent stored items from contacting the floor, from soiling and staining, and from deterioration and damage.

3. Do not leave items uncovered where they might be exposed to weather or become wet; or exposed to heat or sudden changes in temperature or relative humidity; or other sources of deterioration and damage, including dust and other airborne contaminants.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective countertops with undamaged new countertops that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

1.7 WARRANTY

- A. Manufacturer Warranty: Furnish to the Owner a written manufacturer warranty for products and accessories against all patent and latent defects, and incipient and catastrophic failure for 5 years.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Environmental Product Declaration (EPD) criteria.
 1. For products in this section with qualified industry-wide or product-specific EPD, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for additional qualifications and documentation requirements specific to this criteria.
 2. Preference is given to product-specific type III EPDs.
 3. Preference is given to product-specific type III EPDs with LCAs that demonstration reduction in GWP relative to the baseline.
- C. Building Product Disclosure and Optimization: Responsible Sourcing criteria.
 1. Pre-consumer and Post-consumer Recycled Content:

- a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- D. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 5. Preference is given to Declare labels designated as Red List Free.
- E. Low-Emitting Materials criteria:
 1. VOC content criteria:
 - a. For wet-applied on site products in this section, methylene chloride and perchloroethylene may not be intentionally added.
 - b. Adhesives and sealants to meet the SCAQMD Rule 1168, amended October 6, 2017, requirements.
 - 1) Refer to Section 018113 for VOC content limits
 - 2) Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 2. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.
 - b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 SOLID SURFACING MATERIAL

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.3 ACCESSORIES

- A. Adhesive: Structural-grade silicone or epoxy adhesives of type recommended or accepted by manufacturer for conditions of use. Tint adhesive visible in finished work to match countertop materials.
- B. Mounting Spacers: Supplied, required, recommended, or accepted by the adhesive manufacturer, if required.
- C. Sealant:
 - 1. Description: White or clear, medium or high modulus, mildew-resistant silicone sealant conforming to ASTM C 920 requirements for Type S, Grade NS, Class 25, Use NT, A or O sealant, as applicable.
 - 2. Products: "786" manufactured by Dow Corning Corp., or "Sanitary SCS 1700" manufactured by Momentive Performance Materials, Inc., or equal.
- D. Solvent: Supplied, required, recommended, or accepted by the manufacturer to clean countertop surfaces to ensure adhesion of adhesives and sealants.
- E. Cleaning Agents: Provide non-abrasive cleansers supplied, required, recommended, or accepted by the manufacturer.
- F. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

2.4 FABRICATION

- A. Shop-fabricate countertops to sizes and shapes indicated on the Drawings and in largest sections practicable to minimize field jointing.
- B. Fabricate exposed work precise, straight, and true to line, size, and shape; square and within allowable tolerances; and with accurate angles and surfaces, and crisp straight edges.
- C. Cut, drill, and punch countertops as required to receive other components, accessories, hardware, and similar items, and as required to securely attach to supporting construction. Provide openings and similar features as needed to accommodate adjacent work.
- D. Carefully inspect finished units at the shop for conformance to specified requirements for appearance, material, and fabrication. Replace defective units.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install countertops using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.
 - 2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 - 3. Perform drilling and fitting as required or necessary for an accurate fit and complete installation.
 - 4. Installed countertops must be warrantable. Do not install, correct, or replace countertops in a manner that results in any warranty or guarantee becoming void.
- B. Special Techniques:
 - 1. Shim as required using concealed shims.
 - 2. Scribe and fit accurately against adjacent surfaces for a close fit.
 - 3. Attach countertops securely to supports with concealed screws as required for a rigid and secure installation.
 - 4. Seal interface of countertops with contiguous surfaces with sealant.
- C. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach countertops to supporting construction.

- D. Installation Tolerances: Install countertops to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
 - 1. written descriptions of non-conforming, damaged, and defective work;
 - 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 - 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Cleaning Work: Clean all visible surfaces in a manner that does not result any warranty or guarantee becoming void.
 - 1. Use cleaning materials, equipment, and accessories supplied, and means, methods, techniques, and procedures required, recommended, or accepted by the manufacturer.
 - 2. Do not use cleaning materials or procedures known to change, or that might change, the appearance of exposed finishes or adjacent surfaces; or cause deterioration or damage to exposed finishes or adjacent surfaces.
 - 3. Protect adjacent surfaces not being cleaned from staining, deterioration, damage, or other detrimental effects caused by cleaning.
 - 4. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be cleaned to the Architect's acceptance.
- B. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed countertops in place from deterioration, and damage until Substantial Completion.

- B. Do not store anything on, adjacent to, or against installed countertops unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed countertops as work surfaces.
- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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SECTION 12 48 13 – ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Entrance floor mats and frames.
2. Supplementary components and accessories normally furnished or necessary for a complete installation, whether or not such items are indicated on the Drawings or included in the Specifications.

B. Related Requirements:

1. Section 01 81 13.14 for sustainable design requirements.
 - a. Attachment: LEED product data submittal cover sheet.

1.2 REFERENCES

A. Definitions:

1. Manufacturer: Means the floor mat manufacturer, unless otherwise indicated.

1.3 SUBMITTALS

A. Action Submittals: Submit the following for responsive action (formal review and approval).

1. Product Data: Submit manufacturer's product data, specifications, typical installation details, and all other information necessary to show conformance to the Contract Documents, excluding material safety data sheets (MSDSs), and safety data sheets (SDSs), both of which are returned to the Contractor without review or responsive action.
2. Shop Drawings: Include project-specific dimensioned details drawn to scale showing conditions not detailed on the product data; or that are detailed, but not in a manner specific to the project.
3. Samples:
 - a. Submit at least 8-inch square representative samples of each floor mat color, finish, and variety.
 - b. Submit at least 8-inch long representative samples of each frame type color, finish, and variety.

B. Informational Submittals: Submit manufacturer's instructions for information (informal review: responsive action not expected or required, except to record non-conformance with submittal requirements).

1. Submit manufacturer-prepared published instructions for proper installation of furnished floor mats.
2. If manufacturer's instructions are unavailable or do not apply to specific project conditions, then consult the manufacturer's representative and obtain project-specific supplemental instructions printed on manufacturer's letterhead.
3. Promptly distribute supplemental instructions to the Architect, who may have comments that lead to contract modifications or minor changes in the work.

C. Sustainable Design Submittals:

1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet.
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.4 HANDLING

- A. Receiving: Inspect all deliveries for deteriorated, damaged, and defective items.
 1. Reject items that are not packaged in a manner that prevents damage; or that exhibit deterioration or damage or have damaged or open packaging or containers.
 2. Reject items that are not transported, delivered, or protected in conformance with manufacturer-recommended transport, delivery, and receiving requirements.
 3. Unload and store only inspected and accepted items.
- B. Storage: Store unloaded items indoors as shipped, upright in their original packaging or containers, within dry, well-ventilated, broom-cleaned and enclosed storage areas.
- C. Handling: Handle items in conformance with manufacturer's instructions and other requirements and recommendations, and in a manner that that prevents damage. Avoid damage to packaging and containers, and contamination of contents.
- D. Damaged Item Replacement: Promptly remove and replace deteriorated, damaged, or defective floor mats with undamaged new floor mats that do not exhibit deterioration, damage, or defects.
- E. Packaging Waste Management: Do not burn or bury construction waste at the project site. Remove and legally dispose of all construction waste away from the project site.

PART 2 - PRODUCTS

2.1 SUSTAINABLE MATERIALS – LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria:
 - 1. Pre-consumer and Post-consumer Recycled Content:
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- C. Building Product Disclosure and Optimization: Material Ingredient Transparency criteria:
 - 1. For products in this section with qualified material ingredient certifications or transparency reports demonstrating the chemical inventory to at least 0.1% (1000ppm), complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2. Preference is given to products that meet the California Department of Public Health (CDPH) v1.2-2017 testing requirements using the applicable exposure scenario, and VOC limits in addition to having qualified transparency documentation.
 - 3. Preference is given to product inventoried to at least 0.01% (100 ppm).
 - 4. Preference is given to Cradle to Cradle or Material Health Certificates at Silver level or higher.
 - 5. Preference is given to Declare labels designated as Red List Free.
- D. Low-Emitting Materials criteria:
 - 1. VOC emissions criteria or inherently non-emitting:
 - a. All applicable products in this section, as indicated in Section 018113, to meet one of the following criteria.
 - 1) Product meets the California Department of Public Health (CDPH) v1.2-2017 testing requirements and limits.
 - 2) Product is an inherently non-emitting source of VOCs and has no binders, surface coatings, or sealants with organic chemicals.

- b. Complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.

2.2 ENTRANCE FLOOR MATS AND FRAMES

- A. Products: Indicated on the Drawings in the Finish Legend, Sheet A6.30, or equal.

2.3 ACCESSORIES

- A. Fastenings: Provide backings, inserts, loose connection hardware, fasteners, anchors, attachments, connectors, and other items supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.
- B. Other Accessories: Provide accessories and secondary items normally furnished or necessary for a complete installation; or supplied, required, recommended, or accepted by the manufacturer for actual in-service conditions applicable to the project.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Oversight: Ensure an adequate number of supervisors are present and proper supervision practices are followed at the project site before the installer begins work and at all times during installation.
- B. Verification: Verify in-place supporting and adjacent construction conforms to the manufacturer's requirements or recommendations and satisfies all other conditions that might affect the quality of installation or the durability, appearance, or performance of installed and adjacent items.
- C. Evaluation and Assessment:
 - 1. Identify project conditions that do not conform to the manufacturer's instructions and other requirements and recommendations.
 - 2. Perform or arrange and pay costs without reimbursement from Owner for all remedial work necessary to correct or improve deficient conditions, without limitation, before the installer begins work.

3.2 INSTALLATION

- A. General Requirements:
 - 1. Install floor mats using materials and methods required, recommended, or accepted by the manufacturer, along with manufacturer-recommended accessories and techniques.

2. Set items true to line, to required levels and lines, and plumb, level, and square, without warp or rack, with flush well-fitted joints, and in alignment with adjacent construction
 3. Installed floor mats must be warrantable. Do not install, correct, or replace floor mats in a manner that results in any warranty or guarantee becoming void.
- B. Interface with Adjacent Items: Provide materials, components, and accessories normally furnished or necessary to securely attach floor mats to supporting construction.
- C. Installation Tolerances: Install floor mats to an allowable tolerance variation of not more than 1/4-inch from true position and not more than 1/8-inch from plumb, level, and alignment.

3.3 CORRECTION AND REPAIR

- A. Non-conforming, damaged, and defective work must be brought into conformance with the Contract Documents. Correct and repair as necessary, without limitation, including arranging all correction and repair work and paying all correction and repair costs without reimbursement from Owner, until accepted in writing by the Architect.
- B. Corrective and repair work must be performed in conformance with a correction and repair plan submitted to and accepted in writing by the Architect before correction or repair work begins. At a minimum, correction and repair plans must include
1. written descriptions of non-conforming, damaged, and defective work;
 2. supporting sketches, diagrams, photographs, and other visual depictions of non-conforming, damaged, and defective work; and
 3. similar written descriptions and visual depictions of Contractor-proposed corrections and repairs.
- C. Arrange and pay costs without reimbursement from Owner for removing and replacing work that cannot be corrected or repaired to the Architect's acceptance.

3.4 CLEANING

- A. Waste Management: After completing the work of this specification section, leave work areas free from debris, waste, scrap, equipment, tools, and other items.

3.5 PROTECTION

- A. Protect installed floor mats in place from soiling, deterioration, and damage until Substantial Completion.
- B. Do not store anything on or adjacent to or against installed floor mats unless they are protected from damage, as accepted in writing by the manufacturer's representative. Do not use installed floor mats as work surfaces.

- C. Remove protection when it's no longer needed and before Substantial Completion.

END OF SECTION

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Project Manual

Bid Set Submittal

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Volume 2 of 2:
Divisions 21 to 33

LPA

Project No. 30647

March 13, 2025



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DIVISION 21

FIRE SUPPRESSION

SECTION 21 00 00- FIRE SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire Sprinkler design-build installation per NFPA 13.

Note: System to be Single Interlock Preaction Type with electric actuation. Fire Alarm Contractor to provide fire detection and Releasing Panel. (Division 28)

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AHJ: Authority (Authorities) Having Jurisdiction.

B. Definitions:

1. Manufacturer: Fire sprinkler system component assembly manufacturer, unless otherwise indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Fire sprinklers and piping to be fully field coordinated with plumbing, mechanical, electrical, or other concealed work.

1.4 DRAWINGS

- A. Examine Contract Documents prior to bidding of Work and report any discrepancies in writing to Architect.
- B. Drawings showing location of equipment and materials are diagrammatic. Trade coordination will not always permit installation in the locations shown. The fire protection drawings show general arrangement of equipment and materials, etc., and shall be followed as closely as possible for final installation. Building construction, and work of other trades shall be field coordinated.
- C. Architectural and structural Drawings are part of the scope. These Drawings furnish Contractor with information relating to design and construction of the system. Architectural and structural Drawings take precedence over fire protection bid Drawings.
- D. The fire protection Drawings may not include all offsets, fittings, and accessories required in a final installation. Investigate structural and finish conditions affecting the design and plan accordingly. Provide offsets, fittings, and accessories required to meet

final conditions. Inform the Architect immediately if project conditions do not permit installation of equipment and materials in locations shown. Obtain Architects' approval prior to relocation of equipment and materials.

- E. Equipment and materials installed without prior approval of the Architect may be requested to be removed and relocated at Contractors' expense following Architects' direction.
- F. Minor changes in locations of equipment, piping, ducts, etc., from locations shown on contract drawings shall be made when directed by the Architect at no additional cost to the Owner, provided such change is ordered before items of work, or work directly connected to same are installed and provided no additional material is required.
- G. Execute work mentioned in Specifications and not shown on Drawings, or vice versa, the same as if specifically mentioned or shown in both.

1.5 SCOPE OF WORK

- A. Provide all material, labor, design, and services necessary for the installation of the fire suppression sprinkler system described in the Contract Documents.
- B. Scope of Work: Systems are hydraulically designed in accordance with NFPA 13.
- C. For hydraulic calculations, a minimum margin of 10% between demand points and the water supply is required.
- D. Available water supply, a recent flow test will be required for submittal (within 6 months of submittal). Ventura County Fire performed a test on November 14, 2023. 106psi Static 80psi Residual pressure at 1,220 GPM flowing. Refer to bid drawing package.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Qualifications of Contractor: All work shall be performed by a Contractor with a valid C16 California Contractor's license for the design and installation of fire sprinkler systems.
 - 2. The field installation shall be supervised at all times by a journeyman sprinkler fitter or person with equivalent experience.
 - 3. All work shall comply fully with applicable codes and standards. Nothing in the contract documents shall be construed to permit non-compliance with any other code or standard.
 - 4. Warrantee: the contractor shall guarantee all materials, equipment, and workmanship in this installation period of one year from the date of completion. Any system failure during that time shall be repaired at the contractor's expense. Contractor shall respond on site to system problems within 24 hours.

5. All grooved joint couplings, fittings, valves, and specialties shall be of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 6. All castings used for fittings, couplings, valve bodies, etc., shall include a cast date stamp for quality assurance and traceability.
- B. Codes and Standards: The design and installation shall conform to the current edition, based upon state adoptions and amendments at the time of bid, of each of the following:
1. NFPA 13 (as adopted by CFC), "Standard for the Installation of Sprinkler Systems," including all appendices.
 2. NFPA 24 (as adopted by CFC), "Standard for the Installation of Private Fire Service Mains and their Appurtenances," including all appendices.

1.7 APPROVALS

- A. Authority Having Jurisdiction: For purposes of code compliance, the Authority Having Jurisdiction (AHJ) for this installation will be Moorpark Building and Fire Depts. Where there are conflicts between the AHJ and the referenced codes and standards, the more stringent shall apply.

1.8 SUBMITTALS

- A. Prepare and submit installation Shop Drawings, product data. Include:
1. Hydraulic calculations, seismic brace calculations, and all items set forth in NFPA 13.
 2. Product data and samples including a complete list of equipment and products, and a manufacturer's catalog sheet for each item to be included in the work.
 3. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
 4. Material Submittals: Concurrent with submittal of shop drawings, furnish to the A/E in pdf format a complete list of annotated equipment and products, and a manufacturer's catalog sheet for each item to be included in the project. Alternate materials from multiple manufacturers shall not be included.
 5. All material submittals shall include all items listed in the product section of this specification and all additional items necessary to provide a complete installation. Where more than one item appears on a manufacturer's catalog sheet, the item or items to be used shall be indicated.
 6. Shop Drawings: At least 30 working days prior to any installation or fabrication of the system components, the Contractor shall submit in pdf format shop drawing and hydraulic calculations to A/E for review by the A/E. The A/E will review the submittals and make pertinent comments. The contractor will then make any necessary corrections and re-submit the drawings for reconsideration/approval.
 7. Shop drawings shall conform to and include all items as set forth in NFPA 13 for "working plans".

- B. For Substantial Completion, submit (changes clouded) as-built CAD Shop Drawings, and O&M information required manufacturers product data catalog sheets and a completed Contractor's Test and Materials Certificate.
 - 1. Acceptance of the completed work will be granted jointly by the local AHJ. Approval by the local AHJ shall be evidenced in writing and forwarded to A/E as a requirement for Substantial Completion.
 - 2. Close-out Documentation: Submit fire suppression NFPA13; Contractor's Test and Materials Certificate.
 - 3. Record Drawings: Show changes and deviations from the Drawings. Include issued Addendum and any change order items.
 - 4. At the conclusion of the project, provide two (2) sets of as-built drawings, two (2) copies of drawings on CD/USB drive in pdf and AutoCAD format, two (2) operations & maintenance manuals in pdf and hardcopy for all installed equipment and devices and One (1) NFPA 25 standard (California Edition) to the A/E for turning over to the owner's representative. Note: A pdf copy will not be accepted.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials and equipment: All materials and equipment in the system shall be new and current products of a manufacturer regularly engaged in the production of such materials and equipment. Where two or more pieces of equipment are required to perform interrelated functions, they shall be products of one manufacturer.
- B. Approval guides: Unless otherwise indicated, all products shall be listed in the latest publications of Approval Guides for Underwriters Laboratory for the service intended.
- C. Pressure rating: Pressure ratings of all fittings shall meet or exceed maximum working pressures available within the system.
- D. Corrosion protection: All piping and hangers, exposed to the weather or installed in a corrosive atmosphere, shall be protected against corrosion. Piping and hangers in such areas shall be stainless steel and/or hot dipped galvanized. Piping having an external only galvanized finish in such areas is not acceptable.

2.1 PIPE

- A. Schedule of pipe: All pipes shall be ferrous and meet the requirements of NFPA 13. Pipe shall be a minimum of schedule 40 for threaded and cut groove pipe and schedule 10 for roll groove applications. Light wall equivalents are subject to approval.
- B. Galvanized pipe: Non-pressurized fire department pumper connection piping, and pipe located in corrosive environments shall meet the requirements of NFPA 13, be schedule 40 pipe, ferrous, and galvanized, no substitutions.

- C. Underground pipe: All underground piping upstream of the backflow preventer shall be ductile iron class 52 and cement-mortar lined.
- D. Underground pipe: All underground piping downstream of the backflow preventer shall be PVC C900 class 150.
 - Exceptions:
 - i. Piping within 5'-0" of building foundations shall be ductile iron.
 - ii. Piping passing beneath building foundations shall be a 1-piece in-building riser in accordance with NFPA 24, as amended by the California Fire Code.

2.2 FITTINGS AND COUPLINGS

- A. Threaded fittings: Threaded fittings shall be ductile iron class 125, rated for 175 psi cold water working pressure and shall conform to ASME B16.4, and ANSI B2.1 NPT. Malleable and cast-iron threaded fittings are not acceptable.
- B. Nipples: No close nipples are allowed. For short pipe connections use standard short nipples.
- C. Thread-O-Lets: Shop-welded Thread-O-Lets may be used where a certified welder is used, meeting the requirements of this Section.
- D. Plain end couplings: No plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) are allowed.
- E. Hole-cut outlets: No hole-cut outlets are allowed for new sprinkler systems. Hole-cut bolted outlets (mechanical tees) couplings may be used only in isolated locations of existing sprinkler systems. Coupons created by hole-cut outlets shall be secured to the fittings via zip-tie or wire.
- F. Grooved fittings: 90's, 45's, tees, and reducers shall be ductile iron, short-pattern, with flow equal to standard pattern fittings. Adapter flanges (fittings) shall be cast ductile iron/class 125 conforming to ANSI B-16.1, with a rust inhibiting coating. Fittings shall be Victaulic FireLock series or approved equal.
- G. Grooved couplings: Grooved couplings and reducers shall be ductile iron conforming to ASTM A-536, Grade 65-45-12. Coupling gasket shall be molded elastomer (EPDM) per ASTM D2000, Victaulic grade "E" (type A) or approved equal. Grooved couplings and reducers shall be of the same manufacturer as used for the grooved fittings.
- H. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with NFPA-13. Couplings shall be fully installed at visual pad-to-pad offset contact. Tongue and recess type couplings, which require the use of a torque wrench to achieve the exact required gap between housings, are not permitted. Victaulic Style 009H and 107H/107N (Quick-Vic™) or approved equal. Installation ready rigid coupling for direct stab installation without field disassembly.

- I. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Installation-Ready Style 177 or Style 77 or approved equal.

2.3 PIPE THREAD SEALANT

- A. Provide Teflon tape or brush-on pipe thread sealant with Teflon.

2.4 HANGERS AND SUPPORTS

- A. Hangers: Provide hangers to support all piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and to meet the requirements of NFPA 13.
- B. Pipe rings: Pipe rings shall be Tolco Fig. 200 or approved equal. Branch line restraint to be provided where required.
- C. Hanger rods: Hanger rods shall be zinc or electro-galvanized for dry systems.
- D. C-clamps: Equip all c-clamps (beam clamps) with earthquake retaining straps.

2.5 VALVES

- A. Drain valves: Drain valves need only be UL Listed, screw-in bonnet bronze globe valves, rated to 175 psi non-shock cold water working pressure by Nibco, United, or approved equal. Low point drain valves shall have, in addition, a 3/4-inch brass nipple with 3/4-inch mail hose threads and cap.
- B. Outside screw and yoke (OSY) valves: OSY valves shall be cast iron, grooved or flanged and rated for 175 psi, non-shock cold water working pressure. Victaulic Series 771 or approved equal.
- C. Isolation/control valves: Sprinkler system, standpipe, and other approved ground controlling valves shall be gear-operated slow-close butterfly valves with flag type indicator, ductile iron grooved body, EPDM pressure responsive seat, electroless-nickel coated disc, stainless steel stem with bronze bushings, and two internal single-pole, double-throw monitor switches. Victaulic Series 705 or approved equal.
- D. Supervised valves 1½ inches and smaller: Sprinkler controlling valves 1½ inches and smaller shall be slow-close supervised butterfly valve from Nibco, model KT-505-W-8, or approved equal. Valves controlling fire sprinklers in elevator pits shall be unsupervised.
- E. Drain valves: Drain valves need only be UL Listed, screw-in bonnet bronze globe valves, rated to 175 psi non-shock cold water working pressure by Nibco, United, or approved equal. Low point drain valves shall have, in addition, a 3/4-inch brass nipple with 3/4-inch mail hose threads and cap.

- F. Check valves: Check valves shall be grooved, iron body, bronze seat, elastomer coated ductile iron or stainless-steel clapper with a replaceable rubber seal (a rubber seal integral with the seat is not acceptable), and minimum 175 psi non-shock cold water working pressure. Use Victaulic Series 717, Viking Model D, or approved equal.
- G. Backflow prevention assemblies: Provide a USC approved backflow assembly per the County of Ventura Waterworks District 1.
- H. Wafer valves are not acceptable.

2.6 SPRINKLERS

- A. Provide quick response sprinklers, where permitted by NFPA 13.
- B. Provide glass bulb, intermediate temperature, upright, or sidewall heads to meet building conditions.
- C. Sprinklers in unfinished areas shall be brass.

2.7 SPRINKLER PROTECTION

- A. Provide UL Listed sprinkler guards for sprinkler heads subject to mechanical damage or for any sprinkler lower than 7' 0" above the floor.
- B. Guards and escutcheons shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.8 PRESSURE GAUGE

- A. Provide a 3-1/2-inch diameter, bourbon type pressure gauge, 0-300 lbs, and 1/4 inch soft metal seat globe valve with arrangements for draining pipe between gauge and valve, located near each main or floor control valve assembly on the main line or near each test location.

2.9 SLEEVES

- A. Provide 24-gauge galvanized sheet metal with lock seam joints or 1/2-inch overlap sleeves in floors, partitions, ceilings, and in construction without waterproof membranes. Provide schedule 40 galvanized steel pipe sleeves in exterior walls. Provide schedule 40 pipe sleeves with clamp rings in slab-on-grade or exterior walls having below grade penetrations. Provide sleeves through roofs with flashing collars.

2.10 WALL ESCUTCHEON

- A. For exposed pipe installations, provide plastic split ring type escutcheons and paint to match the wall.

2.11 SIGNS

- A. Provide all control, drain and test valves with signs identifying the type of valve, the area (floor or portion of the building) affected by the valve. Signs shall be three-layer etched plastic with red letters on a white background. Letters shall be a minimum of 1/4 inch high. The signs are to be hung by chain from the valve. If the system is a hydraulically calculated system, provide a sign in accordance with NFPA 13.
 - 1. Submit text for approval (ex., "CONTROL VALVE FOURTH FLOOR NORTH")

2.12 SPARE PARTS AND TOOLS

- A. The Contractor shall provide spare sprinklers for maintenance. Minimum quantity of sprinklers required by NFPA 13, for each type, finish, and temperature rating used in the Work.
 - 1. Provide sprinklers to maintenance team for safe keeping.
- B. The Contractor shall provide two (2) sprinkler wrench compatible with each type of sprinkler provided for spare sprinkler cabinet.

2.13 FIRE ALARM AND RELATED EQUIPMENT

- A. Equipment in this section shall be provided, installed, and adjusted by the sprinkler contractor. Conduit, wiring, and terminations shall be by others.
 - 1. Water flow switch: Potter VSR or approved equal.
 - 2. Value supervisor switch: Potter OSYSU-A2 for OSY valves and Potter PCVS-2 for PIV valves or approved equal.
 - a. Butterfly isolation valves shall be equipped with two internal single-pole, double-throw monitoring switches.
 - 3. Supervised valves 1½ inches and smaller: Slow-close supervised butterfly valve from Nibco, model KT-505-W-8, or approved equal.
 - 4. All materials necessary for the installation of an electronic bell on the exterior of building is specified in Division 28.

PART 3 - EXECUTION

1.1 GENERAL

- A. Standards and requirements: Perform all installation work in accordance with the reference standards without exception, and as required by AHJ. Install all piping straight, true, and plumb.
- B. Changes to the approved Shop Drawings: Before making substantive deviations from the approved Shop Drawings, obtain written approval from the A/E and the AHJ. Carefully note any deviations on the Project Record.

- C. Grooved joint couplings and fittings shall be installed in accordance with the manufacturer's written installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be verified as suitable for the intended service prior to installation. Gaskets shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. The contractor shall remove and replace any joints deemed improperly installed.

1.2 DELIVERY AND STORAGE

- A. Protect equipment and materials delivered to Project site from weather, humidity and temperature variations, dirt, dust, and other contaminants.

1.3 COORDINATION

- A. Coordinate Work in this Section with trades covered in other Specification Sections to provide a complete and operable installation of highest quality workmanship.
- B. Arrange pipe spaces, chases, slots and openings in building structure during progress of construction, to accommodate mechanical system installation.
- C. Coordinate installation of supporting devices. Set sleeves in poured-in-place concrete and other structural components during progress of construction.
- D. Coordinate requirements for access panels and doors for mechanical items requiring access where concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.4 PENETRATIONS

- A. Required clearance around pipe: Provide piping that passes through fire rated assemblies, including fire rated GWB assemblies, with clearance around the entire circumference of the pipe as required by NFPA 13. Penetrations of walls, floors or ceilings shall be made in a neat manner using properly sized hole-saw or masonry/concrete coring as necessary.
- B. Fire rated assemblies: The annular space between the wall or pipe sleeve and the sprinkler pipe in fire rated assemblies shall be filled with UL classified fire-stopping material in accordance with the manufacturer's recommendation.
- C. Escutcheons: Where exposed piping or hangers pass through a finished floor, wall or ceiling, install split wall plates or escutcheons fitting securely and snugly and covering the opening.

1.5 INSPECTOR'S TEST AND DRAINS

- A. Auxiliary drains: Provide auxiliary drains at all low points of the system, where the trapped section of pipe exceeds 5 gallons.
 - 1. The drain shall consist of, as a minimum, a valve, a 3/4 inch brass nipple with 3/4 inch male hose threads, and cap.
 - 2. Locate auxiliary drains in unfinished areas, without suspended ceiling, whenever possible.
 - 3. When located in finished areas, with lathe and plaster or GWB locate the hose bib within six (6) inches of an access panel, minimum 12" x 12". When located in toilet rooms the panel shall be stainless steel.

1.6 LAY-IN SUSPENDED CEILINGS

- B. When not indicated otherwise, locate sprinkler heads between at one-quarter or three-quarter points of the tiles, centered in narrow directions and carefully align them in a room.
- C. If hard piping is installed, provide 1 inch clearance with escutcheon around penetrations through suspended ceilings per ASCE requirements.

1.7 INSPECTION AND HYDROSTATIC TESTS

- A. Hydrostatic testing of aboveground piping: Install aboveground piping in such a manner that there will be no visible leakage or drop in gauge pressure when the system is subjected to the hydrostatic pressure test. Test shall be in conformance with NFPA 13 (Revised Zones to be tested at maximum working Static Pressure for 2 hours). The Contractor shall repair any leaks or drips immediately. Do not use additives and corrosive chemicals, sodium silicate or derivatives of sodium silicate, brine, or other corrosive chemicals for testing systems or stopping leaks.
- B. Inspection of piping before installation of wall/ceiling material: Piping, hangers and sway bracing shall be considered satisfactorily installed when the installation is in conformance with the Contractor's approved Shop Drawings and NFPA 13. The Owner and the local AHJ shall approve any deviations from the approved Shop Drawings. When in the opinion of the Owner or the local AHJ representative, the installation deviates greatly from the approved Shop Drawings, revised Shop Drawings and hydraulic calculations may be required to verify the installation.
- C. Partial system test or sprinkler coverage inspections: Perform tests with the sprinklers installed in their final positions. Where it is critical to the continuance of the project as a whole to cover portions of the piping with ceilings or walls prior to the completion of the entire system, perform partial testing of the system after receiving written approval from the A/E. In this case "partial" indicates an entire zone of floor of one system. A satisfactory partial test does not relieve Contractor from performing all final testing procedures.

- D. Final piping inspection: Final sprinkler placement shall be considered satisfactorily complete when all sprinkler heads are installed in accordance with their listing or AHJ approval and the Contractor's approved Shop Drawings. The Contractor may be required to relocate or add additional sprinklers if proper coverage is not provided due to unforeseen or modified architectural conditions.
- E. Final functional test: The final functional test shall be considered satisfactorily complete when all valves and switches perform in accordance with the Contractor's approved Shop Drawings and the following procedures:
 - 1. Operate all control valves to verify proper operation of the valve and associated tamper switch.
 - 2. Operate all test connections to verify water-flow switch operation.
- F. Inspection and test results should be forwarded to the Owner. Should the results of any inspection or test not be satisfactory to the Owner or AHJ, a written list of corrective work items will be provided to the Contractor. The Contractor shall make the required corrections and request re-inspection as a requirement for Substantial Completion.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 220130 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping tube and fitting materials.
 - 2. Pipe joining materials.
 - 3. Transition fittings.
 - 4. Dielectric fittings.
 - 5. Mechanical sleeve seals.
 - 6. Sleeves.
 - 7. Escutcheons.
 - 8. Grout.
 - 9. Demolition.
 - 10. Equipment installation requirements common to equipment sections.
 - 11. Painting and finishing.
 - 12. Concrete bases.
 - 13. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, 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 plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS MATERIALS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 PIPE JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) 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 (3.2 mm) 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, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- 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. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.

2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.3 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Refer to individual Division 23 piping Sections for dielectric fittings not listed below.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms for concrete foundation walls below grade.
- F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.

- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi 28-day compressive strength, unless otherwise indicated in the structural drawings.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
 - 1. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 - 2. 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.
 - 3. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - 4. Install piping to permit valve servicing.
 - 5. Install piping at indicated slopes.
 - 6. Install piping free of sags and bends.
 - 7. Install fittings for changes in direction and branch connections.
 - 8. Install piping to allow application of insulation.
- C. Select system components with pressure rating equal to or greater than system operating pressure.

3.2 ESCUTCHEONS

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with spring clips.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
- f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
- g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.3 PENETRATIONS AND SLEEVES

- A. Sleeves are not required for core-drilled holes.
- B. Permanent sleeves are not required for holes formed by removable PE sleeves.
- C. 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. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 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 Section "Sheet Metal Flashing and Trim" for flashing.
 - d. Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- E. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- G. Verify final equipment locations for roughing-in.
- H. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.7 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic requirements as indicated in the California Building Code.
 - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Verify requirements with equipment anchor bolt edge distances.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section; unless otherwise indicated in structural drawings.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.10 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Grout Installation:
 - 1. Clean surfaces that will come into contact with grout.
 - 2. Provide forms as required for placement of grout.
 - 3. Avoid air entrapment during placement of grout.
 - 4. Place grout, completely filling equipment bases.
 - 5. Place grout on concrete bases and provide smooth bearing surface for equipment.
 - 6. Place grout around anchors.
 - 7. Cure placed grout.

END OF SECTION 230130 220130

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SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Maintenance Data: Include adjustment instructions.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Packing for Packed Expansion Joints: One set for each joint.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.2 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:

EXPANSION FITTINGS AND LOOPS FOR
PLUMBING PIPING

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1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 3. The Metraflex Company: www.metraflex.com/#sle.
 4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Inner Hose: Stainless steel.
- C. Exterior Sleeve: Single braided, stainless steel.
- D. Pressure Rating: 125 psi up to 12 inch.
- E. Maximum Service Temperature: 250 degrees F.
- F. End Connections: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch on each side of installed center line.

2.3 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 2. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 3. The Metraflex Company: www.metraflex.com/#sle.
 4. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch.
- E. Maximum Service Temperature: 250 degrees F.
- F. End Connections: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch on each side of installed center line.
- I. Application: Copper piping.

2.4 EXPANSION JOINTS - STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
1. Flex-Weld, Inc: www.kelcoind.com/#sle.

2. Mercer Rubber Company: www.mercer-rubber.com/#sle.

- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 1-3/4 inches.
- D. Maximum Extension: 1/4 inch.
- E. Joint Type: Externally pressurized with flanged ends.
- F. Size: Use pipe sized units.
- G. Application: Steel piping 4 inches and under.

2.5 EXPANSION JOINTS - EXTERNAL RING CONTROLLED STAINLESS STEEL BELLOWS TYPE

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
- B. Pressure Rating: 125 psi and 400 degrees F.
- C. Maximum Compression: 15/16 inch.
- D. Maximum Extension: 5/16 inch.
- E. Maximum Offset: 1/8 inch.
- F. End Connections: Flanged.
- G. Size: Use pipe sized units.
- H. Application: Steel piping over 2 inches.

2.6 EXPANSION JOINTS - COMPENSATORS

- A. Manufacturers:
 - 1. Mercer Rubber Company: www.mercer-rubber.com/#sle.
 - 2. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Type: Two-ply 304 stainless steel bellows with carbon steel shroud.
- C. Maximum Working Pressure: 200 psi.
- D. Maximum Working Temperature: 400 degrees F.
- E. Maximum Compression: 1/2 inch.

- F. Maximum Extension: 5/32 inch.
- G. End Connections: Female copper sweat.
- H. Application: Copper piping up to 3 inches in size or steel piping up to 4 inches in size.

2.7 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch in the x, y, and z planes with no thrust loads to the building structure.
- D. Maximum Working Pressure: 150 psi at 800 degrees F.
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment.
 - 1. Selected Product to Accommodate:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 2. Provide necessary accessories including, but not limited to, swivel joints.

2.8 EXPANSION JOINTS - EXTERNALLY PRESSURIZED

- A. Manufacturers:
 - 1. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 2. The Metraflex Company: www.metraflex.com/#sle.
 - 3. Unisource Manufacturing, Inc: www.unisource-mfg.com/#sle.
- B. Bellows Type: Two-ply, single bellows constructed of 304 stainless steel.
- C. Internal Liner: Carbon steel with internal and external guides.
- D. Specialty: Carbon steel anchor base, lifting lugs, and drain port with tapered plug.
- E. End Connections: Class 150, carbon steel, welded flange.
- F. Maximum Axial Compression: 4 inches.
- G. Maximum Working Pressure: 150 psi at 700 degrees F.

H. Application: Steel piping 2 inches and over.

2.9 ACCESSORIES

A. Pipe Alignment Guides:

1. Manufacturers:
 - a. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - b. The Metraflex Company: www.metraflex.com/#sle.
2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inches travel.

B. Swivel Joints:

1. Fabricated steel body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- D. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- E. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION 220516

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.
- D. Section 220719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Valve Stem Packings: Two for each type and size of valve.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
 - 1. Minimum three years experience.
- C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Manufacturers:
 - 1. Flexicraft Industries: www.flexicraft.com.
- B. Vertical Piping:
 - 1. Sleeve Length: 1 inch above finished floor.
 - 2. Provide sealant for watertight joint.
 - 3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
 - 4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Zinc coated or cast iron pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.

F. Clearances:

1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC: www.apsonline.com/#sle.
2. American Polywater Corporation: www.polywater-haufftechnik.com/#sle.
3. Flexicraft Industries: www.flexicraft.com/#sle.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
5. Glass-reinforced plastic pressure end plates.

C. Sealing Compounds:

1. Provide packing and sealing compound to fill pipe to sleeve thickness.
2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.

D. Pipe Sleeve Material:

1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
2. Masonry Structures: Sheet metal or fiber.

E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

F. Sleeve-Forming Disk: Non-conductive plastic-based material, 3 inch thick.

G. Pipeline-Casing Seals:

1. End Seals: 1/8 inch, pull-on type, rubber or synthetic rubber based.

PART 3 EXECUTION

3.1 PREPARATION

SLEEVES AND SLEEVE SEALS FOR PLUMBING
PIPING

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 - 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
 - 3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
 - 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
 - 1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 - 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 - 3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 220517

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SECTION 220519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flow meters.
- B. Pressure gauges.
- C. Thermometers.
- D. Pressure-temperature test plugs.

1.2 REFERENCE STANDARDS

- A. AGA/ANSI B109 Set - INCLUDES ANSI B109.1, ANSI B109.2, ANSI B109.3, ANSI B109.4; 2000.
- B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- C. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- D. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- E. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- F. AWWA C700 - Cold-Water Meters -- Displacement Type, Metal Alloy Main Case; 2020.
- G. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2012.
- H. AWWA C702 - Cold-Water Meters -- Compound Type; 2010.
- I. AWWA C703 - Cold-Water Meters -- Fire-Service Type; 2019.
- J. AWWA C704 - Propeller-Type Meters for Waterworks Applications; 2019.
- K. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2010.
- L. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- M. FM (AG) - FM Approval Guide; Current Edition.

- N. IEEE 802.3 - Standard Information Technology--Telecommunications and Information Exchange Between Systems--Specific Requirements Part 3: CSMA/CD Access Method and Physical Layer Specifications; 2014.
- O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- P. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- Q. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- R. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- S. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.
- C. Project Record Documents: Record actual locations of components and instrumentation.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements. for additional provisions.

PART 2 PRODUCTS

2.1 FLOWMETERS

- A. In-Line Monitor:
 - 1. Accuracy: Plus or minus five percent full scale.
 - 2. Flow: Water, flow-range as indicated on drawings.
 - 3. Connection Size: 1 inch NPT female.
 - 4. Maximum Service Pressure: 200 psi.
 - 5. Range marks to bear metric and English (dual) scale with gpm units.

B. Flow Sensing Element.

1. In-Line Averaging Measuring Station: Type 316 stainless steel pitot type flow element inserted through welded threaded couplet, with safety shut-off valves and quick coupling connections, and permanent metal tag indicating design flow rate, reading for design flow rate, metered fluid, line size, station or location number.
 - a. Pressure rating: 275 psi.
 - b. Maximum temperature: 400 degrees F.
 - c. Accuracy: Plus 0.55 percent to minus 2.30 percent.

2.2 PRESSURE GAUGES

A. Bourdon Tube for Liquids and Gases:

1. Dial Size and Cover: 4-1/2 inch diameter scale with polycarbonate window.
2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
4. Process Connection: Lower-back, 1/4 inch NPT male except where noted.

2.3 THERMOMETERS

A. General:

1. Product Compliance: ASTM E1.
2. Lens: Clear glass, except where stated.
3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

B. Thermometers - Straight: 5 inch v-shape lead-free brass case with clear glass window scale, 2 inch NPT stem, 3-1/4 inch NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.

C. Thermometers - Adjustable Angle: 7 inch v-shape aluminum case with clear glass window scale, 6 inch NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.

D. Thermometers - Dial Type:

1. Fixed: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
2. Adjustable Angle: 5 inch diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch NPT stem.
3. Vapor (Gas) Actuated: 4-1/2 inch glass-reinforced phenolic case, aluminum dial with black pointer, recalibrating screw, 2 inch brass thermowell, adjustable joint with positive locking device allowing 180 degrees in vertical plane adjustment and capillary.

2.4 PRESSURE-TEMPERATURE TEST PLUGS:

- A. Size: 500 psi capacity; 1/2 inch MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch pressure gauge or temperature probe.
- B. Wetted Materials per Temperature Range:
 - 1. Up to 200 degrees F: Brass probe with neoprene core.
- C. Test Kit: Internally padded carrying case fitted with two 2-1/2 inch diameter pressure gauges, adapters, two 1/8 inch probes, and 1 inch dual-scale dial thermometers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.2 INSTALLATION

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Install rotameters (flowmeters) between 4 to 6 ft above finished floor unless instructed otherwise to allow easy readability.
- D. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 - 2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
 - 3. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Angle valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Gate valves.
- F. Globe valves.
- G. Lubricated plug valves.

1.2 RELATED REQUIREMENTS

- A. Section 083100 - Access Doors and Panels.
- B. Section 220553 - Identification for Plumbing Piping and Equipment.
- C. Section 220719 - Plumbing Piping Insulation.
- D. Section 221005 - Plumbing Piping.
- E. Section 221500 - General-Service Compressed-Air Systems.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. PTFE: Polytetrafluoroethylene.
- F. WOG: Water, oil, and gas.
- G. WSP: Working steam pressure.

1.4 REFERENCE STANDARDS

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).
- L. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- M. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015 (Reapproved 2021).
- N. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- O. MSS SP-45 - Drain and Bypass Connections; 2020.
- P. MSS SP-67 - Butterfly Valves; 2022.
- Q. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- R. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- S. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- T. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.

- U. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- V. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- W. MSS SP-125 - Check Valves: Gray Iron and Ductile Iron, In-Line, Spring-Loaded, Center-Guided; 2018.
- X. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- Y. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.6 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.
 - 6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - a. Provide temporary inlet and outlet caps.

- b. Maintain caps in place until installation.
- 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.
 - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

1.8 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Handle large valves with sling, modified to avoid damage to exposed parts.
- B. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, butterfly, gate or plug.
 - 2. Throttling: Provide globe, ball, or butterfly.
 - 3. Swing Check (Pump Outlet):
 - a. 2 inch and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. 2-1/2 inch and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:
 - 1. Steel Pipe:
 - a. 2 inch and Smaller: Threaded ends.
 - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 2. Copper Tube:
 - a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - b. 2-1/2 inch to 4 inch: Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
- F. Domestic, Hot and Cold Water Valves:
 - 1. 2 inch and Smaller:
 - a. Bronze: Provide with threaded or Viega ProPress ends.
 - b. Bronze Angle: Class 125, bronze disc.

- c. Ball: Two piece, full port, brass with brass trim.
- d. Bronze Swing Check: Class 125, bronze disc.
- e. Bronze Gate: Class 125, NRS.
- f. Bronze Globe: Class 125, bronze disc.
- 2. 2-1/2 inch and Larger:
 - a. Iron, 2-1/2 inch to 4 inch: Provide with threaded or flanged ends.
 - b. Iron Ball: Class 150.
 - c. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.
 - d. Iron Swing Check: Class 125, metal seats.
 - e. Iron Swing Check with Closure Control: Class 125, lever and spring.
 - f. Iron Center-Guided Check: Class 125, compact-wafer, metal seat.
 - g. Iron Plate-Type Check: Class 125; single plate; metal seat.
 - h. Iron Gate: Class 125, NRS.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch and larger.
 - 2. Handwheel: Valves other than quarter-turn types.
 - 3. Hand Lever: Quarter-turn valves 2 inch and smaller except plug valves.
 - 4. Wrench: Plug valves with square heads.
- D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
 - 1. Gate Valves: Rising stem.
 - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch through 24 inch: ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Solder-joint Connections: ASME B16.18.
 - 3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:

1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRASS, BALL VALVES

A. Two Piece, Full Port with Brass Trim and Female Thread Connections:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged brass.
5. Seats: PTFE.
6. Ball: Chrome-plated brass.
7. Operator: Lockable handle and memory stop.

B. Two Piece, Full Port with Press Connections:

1. WOG Rating: 250 psi.
2. Body: Forged brass.
3. Seats: EPDM.
4. Ball: Chrome-plated brass.
5. Blow-out Proof Stem: Forged brass.
6. Operator: Provide lockable handle.
7. Maximum Service Temperature: 250 degrees F.

2.4 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze or dezincified-brass alloy.
5. Ends Connections: Pipe thread or solder.
6. Seats: PTFE.
7. Stem: Bronze, blowout proof.
8. Ball: Chrome plated brass.
9. Operator: Provide lockable handle and stem extension.

2.5 IRON, BALL VALVES

- A. Class 125, Full Port, Stainless Steel Trim:
 - 1. Comply with MSS SP-72.
 - 2. CWP Rating: 200 psi.
 - 3. Body: ASTM A536 Grade 65-45-12, ductile iron.
 - 4. End Connections: Flanged.
 - 5. Seats: PTFE.
 - 6. Operator: Lever with locking handle.

2.6 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style; Bi-directional dead-end service without use of downstream flange:
 - 1. Class 125 or Class 150 flanges.
 - 2. Comply with MSS SP-67, Type I.
 - 3. Lug Style, Service Pressure Ratings:
 - a. 100 psi for sizes 14 to 24 inch.
 - b. 150 psi for sizes 2 to 12 inch.
 - c. Vacuum down to 29.9 in-Hg.
 - 4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
 - 5. Stem: One or two-piece stainless steel.
 - 6. Seat: EPDM.
 - 7. Disc: Stainless steel.
 - 8. Finish: Epoxy coated.
 - 9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.7 BRONZE, LIFT CHECK VALVES

- A. General:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
 - 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 - 2. CWP Rating: 200 psi.
 - 3. Design: Vertical flow.
 - 4. Body: Comply with ASTM B61 or ASTM B62, bronze.
 - 5. End Connections: Threaded.
 - 6. Disc (Type 1): Bronze.

2.8 BRASS, HORIZONTAL SWING CHECK VALVES

- A. Class 125, Threaded End Connections:
 - 1. WOG Rating: 200 psi.
 - 2. Body: Forged brass.

3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.

B. Class 125, Press End Connections:

1. WOG Rating: 200 psi.
2. Body: Forged brass.
3. Disc: Forged brass.
4. Hinge-Pin, Screw, and Cap: Forged brass.

2.9 BRONZE, SWING CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:

1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WOG Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded.
6. Disc: Bronze.

2.10 FLOW LIMITING VALVES

- A. Size: As indicated on drawings, female threaded.
- B. Flow Accuracy: Plus or minus 5 percent.
- C. Body and Cap: Lead-free brass.
- D. Cap and Plug: Lead-free brass.
- E. Cartridge: Stainless steel with replaceable EPDM seal.
- F. Maximum Service Pressure: 600 psi, WOG.
- G. Maximum Service Temperature: 250 degrees F.

2.11 BRONZE, GATE VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Non-Rising Stem or NRS

1. Pressure-Temperature Range: MSS SP-80, Type I.

2. Class 125:
3. Class 150: CWP Rating; 300 psi.
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron.

2.12 IRON, GATE VALVES

- A. Bolted Bonnet: OS&Y; Rising Stem:
1. Pressure and Temperature Rating: MSS SP-70, Type I.
 2. Class 125: WOG Rating; 200 psi.
 3. Body: ASTM A126, gray iron with bolted bonnet.
 4. End Connections: Flanged.
 5. Trim: Bronze.
 6. Disc: Solid wedge.
 7. Packing and Gasket: Asbestos free.

2.13 BRONZE, GLOBE VALVES

- A. General:
1. Fabricate from dezincification resistant material.
 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125 and Class 250:
1. Class 125:
 - a. WOG Rating: 200 psi.
 - b. WSP Rating: 125 psi, saturated.
 2. Class 250: WOG Rating; 300 psi.
 3. Comply with MSS SP-80, Type 1.
 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
 5. End Connections: Threaded or solder.
 6. Bonnet: NRS; Non-rising Stem.
 7. Non-Rising Stem: Bronze.
 8. Disc: PTFE.
 9. Packing: Asbestos free.
 10. Handwheel Operator: Malleable iron.

2.14 LUBRICATED PLUG VALVES

- A. Regular Gland with Threaded Ends:
1. Comply with MSS SP-78, Type II.
 2. Class 125: CWP Rating: 200 psi.

3. Body: ASTM A48/A48M or ASTM A126, cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prefabricated trapeze-framed systems.
- B. Strut systems for pipe or equipment support.
- C. Beam clamps.
- D. Pipe hangers.
- E. Pipe rollers and roller supports.
- F. Pipe supports, guides, shields, and saddles.
- G. Seismic bracing hardware.
- H. Nonpenetrating rooftop supports for low-slope roofs.
- I. Anchors and fasteners.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2022.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).

- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I. 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; 2023.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- M. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- N. FM (AG) - FM Approval Guide; Current Edition.
- O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- P. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Q. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
 1. Fiberglass Strut Channel Framing Systems: Include requirements for strength derating according to ambient temperature.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports: Comply with Section 055000.
 - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
 - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.
 - 1. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - 2. Outdoor, Damp, or Wet-Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

2.2 PREFABRICATED TRAPEZE-FRAMED SYSTEMS

- A. Prefabricated Trapeze-Framed Metal Strut Systems:
 - 1. Manufacturers:
 - a. Anvil International, LLC: www.asc-es.com/#sle.
 - b. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Strut Channel or Bracket Material:
 - a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
 - 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 - 5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- B. Prefabricated Trapeze-Framed Fiberglass Strut Systems:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 59, prefabricated continuous-slot fiberglass strut channel, associated fittings, and related accessories.
 - 3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.

2.3 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

A. Strut Channels:

1. Manufacturers:
 - a. ABB Installation Products: electrification.us.abb.com/#sle.
 - b. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
3. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:

1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Piping up to 1 inch: 1/4 inch diameter.
 - c. Piping larger than 1 inch: 3/8 inch diameter.
 - d. Trapeze Support for Multiple Pipes: 3/8 inch in length.

C. Channel Nuts:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.4 BEAM CLAMPS

A. Manufacturers:

1. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
2. FNW: www.fnw.com/#sle.
3. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

C. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.

- D. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- E. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- F. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- G. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish.
- H. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- I. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.5 PIPE HANGERS

- A. Band Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Gripple, Inc: www.gripple.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. J-Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 5, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 - 3. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.
- C. Swivel Ring Hangers, Adjustable:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 10, epoxy-painted, zinc-colored.

3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

D. Clevis Hangers, Adjustable:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
6. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
7. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch.

2.6 PIPE CLAMPS

A. Riser Clamps:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

B. Extension Split Pipe Clamp:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7001: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
3. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
4. Provide hanger rod and nuts of the same type and material for a given pipe run.
5. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

C. Strut Clamps:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW; 7815: www.fnw.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
3. Cushioned Pipe or Tubing Strut Clamp: Provide strut clamp with thermoplastic elastomer cushion having dielectric strength of 670 V/mil.
4. Service Temperature Range: Minus 65 to 275 degrees F.

D. Insulation Coupling:

1. Manufacturers:
 - a. FNW: www.fnw.com/#sle.
 - b. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - c. Unistrut, a brand of Atkore International, Inc: www.unistrut.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Two bolt-type clamps designed for installation under insulation.
3. Material: Carbon steel with epoxy copper or zinc finish.

2.7 PIPE ROLLERS AND ROLLER SUPPORTS

A. Manufacturers:

1. ASC Engineered Solutions: www.asc-es.com/#sle.
2. FNW: www.fnw.com/#sle.
3. nVent Caddy, a brand of nVent: www.erico.com/#sle.
4. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

B. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

C. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

2.8 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Stanchions:
 - 1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
 - 3. Provide coated or plated saddles to isolate steel hangers from dissimilar metal tube or pipe.
 - 4. For pipe runs, use stanchions of same type and material where vertical adjustment is required for stationary pipe.
- C. U-Bolts:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 24, carbon steel u-bolt for pipe support or anchoring.
- D. Intermediate Anchors and Pipe Alignment Guides:
 - 1. Manufacturers:
 - a. Anvil International, LLC: www.anvilintl.com/#sle.
 - b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Pipe Sizes 6 inch and Smaller: Minimum clearance of 0.16 inch.
 - 3. Pipe Size 8 inch: 0.625 inch U-bolt with double nuts providing minimum clearance of 0.28 inch.
 - 4. Pipe Size 10 inch: 0.75 inch U-bolt.
 - 5. Pipe Sizes 12 to 16 inch: 0.875 inch U-bolt.
 - 6. Pipe Sizes 18 to 30 inches: 1 inch U-bolt.
 - 7. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- E. Pipe Alignment Guides, Galvanized steel:
 - 1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.

- b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Pipe Sizes 8 inch and Smaller: Spider or sleeve type.
- F. Pipe Shields for Insulated Piping:
 1. Manufacturers:
 - a. Anvil International: www.anvilintl.com/#sle.
 - b. FNW: www.fnw.com/#sle.
 - c. Gregory Industries, Inc: www.gregorycorp.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
 3. General Construction and Requirements:
 - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
 - b. Shields Material: UV-resistant polypropylene with glass fill.
 - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
 - d. Service Temperature: Minus 40 to 178 degrees F.
 - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- G. Pipe Supports:
 1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 2. Liquid Temperatures Up to 122 degrees F:
 - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
 - b. Support From Below: MSS SP-58 types 35 through 38.
- H. Pipe Supports, Thermal Insulated:
 1. Manufacturers:
 - a. Buckaroos, Inc: www.buckaroos.com/#sle.
 - b. KB Enterprises: www.snappitz.com/#sle.
 2. General Requirements:
 - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
 - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - c. Provide pipe supports for 1/2 to 30 inch iron pipes.
 - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
 3. PVC Jacket:

- a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
- b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
- c. Minimum Thickness: 60 mil, 0.06 inch.

I. Copper Pipe Supports:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Source Limitations: Furnish supports, associated fittings, accessories, and hardware produced by single manufacturer.

J. Thermal Insulated, Surface-Mounted Pipe Supports:

1. Manufacturers:
 - a. FNW: www.fnw.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Material: Carbon steel with epoxy copper or zinc finish.
3. Weather and UV light resistant foam, plastic, or rubber material with built-in strut.
Maximum Load: 50 lb for single pipe or multiple landed on top strut.

K. Overhead Pipe Supports:

1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

L. Plenum Pipe Supports:

1. Manufacturers:
 - a. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

2.9 SEISMIC BRACING HARDWARE

A. Cable Suspension Systems:

1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Strut channel or bracket-fitted fitting with locking mechanism for pipe or equipment suspension using cable wires extended to surface-mounted end-fixing fittings.

3. Provide cable wire and end-fixing as required to hold minimum weight of 120 lb.
- B. Cable Sway Bracing Systems:
1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 2. Cable wire hanger with fix and release spring mechanism enclosed using zinc housing with 302 stainless steel components for pipe or equipment suspension to surface-mounted end-fixing fittings.
 3. Provide cable wire and end-fixing as required to hold minimum weight of 25 lb.

2.10 NONPENETRATING ROOFTOP SUPPORTS FOR LOW-SLOPE ROOFS

- A. Manufacturers:
1. Anvil International: www.anvilintl.com/#sle.
 2. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 3. MIFAB MFG: www.mifab.com.
 4. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 5. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
- B. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
- C. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
- D. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
- E. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.11 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
1. Hilti, Inc: www.us.hilti.com/#sle.
 2. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 3. Powers Fasteners, Inc: www.powers.com/#sle.
 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

- C. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- D. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- E. Hollow Masonry: Use toggle bolts.
- F. Hollow Stud Walls: Use toggle bolts.
- G. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- H. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- I. Sheet Metal: Use sheet metal screws.
- J. Wood: Use wood screws.
- K. Plastic and lead anchors are not permitted.
- L. Powder-actuated fasteners are not permitted.
- M. Hammer-driven anchors and fasteners are not permitted.
- N. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
- O. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Channel Material: Use galvanized steel.
 - 2. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
 - 3. Manufacturer: Same as manufacturer of metal strut channel framing system.
- P. Concrete Inserts:
 - 1. Manufacturers:
 - a. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
 - b. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - c. nVent Caddy, a brand of nVent: www.erico.com/#sle.
 - d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.

- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 220529

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SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. Seismic restraint systems.

1.2 DEFINITIONS

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; 2015.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).

- I. MFMA-4 - Metal Framing Standards Publication; 2004.
- J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.

- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Piping Isolation:
 - 1. Provide vibration isolators for piping supports:
 - a. Located in equipment rooms.
 - b. Located within 50 feet of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
 - c. For piping over 2 inch located below or within 50 feet of noise-sensitive areas indicated.

2.2 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- D. Seismic Restraints:
 - 1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Plumbing components where either of the following apply:
 - (a) The component importance factor (I_p) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.

- 2) Plumbing piping with component importance factor (I_p) of 1.5 and nominal pipe size of 2 inch or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
- b. Plumbing Piping Exemptions, All Seismic Design Categories:
 - 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported piping weighing less than 10 pounds per foot, where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
 - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.
 - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds or less.
 - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (I_p) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds or less.

- (e) Hanger supported piping with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, where pipe has a component importance factor (I_p) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds or less.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. FEMA 412.
 - b. FEMA 413.
 - c. FEMA 414.
 - d. FEMA E-74.
 - e. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 5. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
 - c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

E. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners except where permitted by applicable code.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads) except where permitted by applicable code. Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

F. Seismic Interactions:

1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

G. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

2.3 SEISMIC RESTRAINT SYSTEMS

A. Manufacturers:

1. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

C. Cable Restraints:

1. Comply with ASCE 19.
2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.

3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut) for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 1. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 2. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 3. Adjust isolators to be free of isolation short circuits during normal operation.
 4. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
 1. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 2. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 3. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 4. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.

- b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
- 5. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 - 1. Verify isolator static deflections.
 - 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Seismic Controls:
 - 1. Verify snubbing element air gaps.
- E. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 220548

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. Valve tags.
 - 5. Underground warning tape.
 - 6. Ceiling tacks.
 - 7. Warning tags.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: For each type of product indicated.
- 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 Schedule: For each piping system to include in maintenance manuals.
- F. Schedules:
 - 1. Submit plumbing component identification schedule listing equipment, piping, and valves.
 - 2. Detail proposed component identification data in terms of of wording, symbols, letter size, and color coding to be applied to corresponding product.
 - 3. Valve Data Format: Include id-number, location, function, and model number.

1.5 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 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch diameter and smaller.
 - 2. Manual operated and automated control valves.
 - 3. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- C. Pipe Markers: 3/4 inch diameter and higher.

2.2 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 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. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 3. 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).

4. 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.
 5. Fasteners: Stainless steel rivets or self-tapping screws.
 6. 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 Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.3 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. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- C. 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).
- D. 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.
- E. Fasteners: Stainless steel rivets or self-tapping screws.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 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.

2.5 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: Bras 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.

2.7 TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
 - 2. Brady Corporation: www.bradycorp.com/#sle.
 - 3. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 5. Seton Identification Products: www.seton.com/#sle.
- B. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

- C. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- D. Piping: 3/4 inch diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

2.8 PIPE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradycorp.com/#sle.
 - 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches wide by 4 mil, 0.004 inch thick, manufactured for direct burial service.
- F. Identification Scheme, ASME A13.1:
 - 1. Primary: External Pipe Diameter, Uninsulated or Insulated.
 - a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
 - b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
 - c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
 - d. 8 to 10 inches: Use 24 inch field-length with 2-1/2 inch text height.
 - 2. Secondary: Color scheme per fluid service.
 - a. Compressed Air: White text on blue background.
 - b. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
 - 3. Tertiary: Other Details.
 - a. Directional flow arrow.

2.9 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyyd.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 4. Seton Identification Products: www.seton.com/#sle.

- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil, 0.004 inch.
- D. Legend: Type of service, continuously repeated over full length of tape.

2.10 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark: www.craftmarkid.com/#sle.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
 - 1. Plumbing Equipment: Yellow.
 - 2. Plumbing Valves: Green.
 - 3. Heating/Cooling Valves: Blue.

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.
- B. Degrease and clean surfaces to receive identification products.

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 other sections.
- 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 (15m) 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 space labels.

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 rough-in connections on 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: 2 inches (50 mm) round.
 - b. Hot Water: 2 inches (50 mm) round.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to equipment and other items where required.

3.6 INSTALLATION

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- F. Apply ASME A13.1 Pipe Marking Rules:
 1. Place pipe marker adjacent to changes in direction.
 2. Place pipe marker adjacent each valve port and flange end.
 3. Place pipe marker at both sides of floor and wall penetrations.
 4. Place pipe marker every 25 to 50 feet interval of straight run.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

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END OF SECTION 220553

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:
 - 1. Insulation Materials:
 - 2. Flexible elastomeric cellular insulation.
 - a. Flexible elastomeric.
 - b. Glass fiber insulation.
 - c. Polyethylene insulation.
 - d. Mineral fiber.
 - 3. Adhesives.
 - 4. Sealants.

1.3 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.4 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- C. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- D. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).
- E. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.

- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- C. Qualification Data: For qualified installer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed work.

1.7 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.

1.8 COORDINATION

- A. Coordinate clearance requirements with piping installer for piping insulation application and equipment installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 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.

1.10 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- C. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

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. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class 1.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc; Aerocel.
 - b. Armacell LLC; 520 Adhesive.
 - c. Foster Products Corporation, H.B. Fuller Company; 85-75.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. 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 Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H.B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. PVC Jacket Adhesive: Compatible with PVC Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

- A. Joint Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 4. Color: White or gray.
 5. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H.B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc; 405.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire and water resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
 6. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire and water resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.
6. For indoor applications, use sealants that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.5 GLASS FIBER INSULATION

- A. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
 1. K Value: ASTM C177, 0.23 at 75 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Maximum Moisture Absorption: 0.2 percent by volume.
- B. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

2.6 POLYETHYLENE INSULATION

- A. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
 1. K Value: ASTM C177; 0.25 at 75 degrees F.
 2. Maximum Service Temperature: 200 degrees F.
 3. Density: 2 pcf.
 4. Maximum Moisture Absorption: 1.0 percent by volume.
 5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
 6. Connection: Contact adhesive.

2.7 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
 1. Minimum Service Temperature: Minus 40 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
 3. Connection: Waterproof vapor barrier adhesive.

2.8 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:

- B. PVC Jacket: One piece molded type fitting covers and sheet material, off-white color.
 - 1. Minimum Service Temperature: 0 degrees F.
 - 2. Maximum Service Temperature: 150 degrees F.
 - 3. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
 - 4. Thickness: 10 mil, 0.010 inch.
 - 5. Connections: Brush on welding adhesive.
 - 6. Covering Adhesive Mastic: Compatible with insulation.
- C. Aluminum Jacket:
 - 1. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that system and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry, with foreign material removed.
 - 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 dry surfaces to receive 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 range between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thickness required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachments 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 adhesive, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3 inch (75 mm) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) O.C.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) O.C.
 4. For below ambient services, apply vapor-barrier mastic over staples.
 5. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 6. 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 separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same 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. Name plates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetration.
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 applicaitons requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulations, 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 Fire-Rated 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 for fire-rated walls and partitions.
1. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements for firestopping and fire-resistive joint sealers listed in other sections.
 3. General pipe insulation installation.
- G. Requirements in this artical generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- H. 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. Insulated pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be 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 with preformed fitting insulation or sectional pipe insulation fo same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less that 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 with 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 mech. 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.
- I. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- J. 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 the 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.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 4. Secure insulation to flange and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allows 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 allows 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 allows passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of performed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) O.C.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight piping 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 performed 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 performed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.7 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
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.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform test and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. 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 "Pipe Insulation Schedule, General" Article.

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 personal injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1 (DN 25) and Smaller: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - 2. NPS 1-1/4 (DN 32) and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.
- B. Condensate and Equipment Drain Water below 60 Deg F (16 deg C):
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.11 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- F. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
 - 1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- H. Inserts and Shields:
 - 1. Application: Piping 1-1/2 inches diameter or larger.
 - 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 - 3. Insert Location: Between support shield and piping and under the finish jacket.
 - 4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
 - 5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- I. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 078400.
- J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with aluminum jacket.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

END OF SECTION 220719

SECTION 221005 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet of building.
- D. Domestic water piping, above grade.
- E. Storm drainage piping, buried within 5 feet of building.
- F. Storm drainage piping, above grade.
- G. Sanitary Vent.
- H. Pipe flanges, unions, and couplings.
- I. Pipe hangers and supports.
- J. Pipe sleeve-seal systems.
 - 1. Ball valves.
 - 2. Butterfly valves.
 - 3. Balancing valves.
- K. Pressure reducing valves.
- L. Pressure relief valves.
- M. Pressure-temperature valves.
- N. Strainers.
- O. Indirect and Condensate

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 083100 - Access Doors and Panels.
- C. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.
- D. Section 220529 - Hangers and Supports for Plumbing Piping and Equipment.

- E. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- F. Section 220553 - Identification for Plumbing Piping and Equipment.
- G. Section 220719 - Plumbing Piping Insulation.
- H. Section 312316 - Excavation.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ANSI Z223.1 - National Fuel Gas Code; 2024.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- G. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2017.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.
- J. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Potable Water Distribution Systems; 2020.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- L. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- M. ASTM B32 - Standard Specification for Solder Metal; 2020.
- N. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- O. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.

- P. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- Q. ASTM D2321- Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- R. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- S. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.
- T. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- U. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- V. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- W. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- X. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- Y. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- Z. AWWA C550 - Protective Interior Coatings for Valves and Hydrants; 2017.
- AA. AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).
- BB. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- CC. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- DD. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- EE. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

FF. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

GG. NSF 61 - Drinking Water System Components - Health Effects; 2023.

HH. NSF 372 - Drinking Water System Components - Lead Content; 2022.

II. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.
- C. Product Origin: Each pipe and fitting shall be marked with the following: Manufacturer's name or registered trademark, Country of Origin, date of manufacture (pipe materials only).

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.
- F. Made in USA: All piping products shall be manufactured and fabricated in the United States and produced from materials that is made and melted in the United States.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

2.2 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Hubless Cast Iron Pipe and Fittings:
 - 1. Pipe Fittings: ASTM A 888 or CISPI 301.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
 - 3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
 - a. Sanitary Sewer And Vent Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
- B. DWV Copper Pipe And Fittings - Forced Main:
 - 1. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.3 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

- A. Hubless Cast Iron Pipe and Fittings:
 - 1. Pipe Fittings: ASTM A 888 or CISPI 301.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
 - a. Vent Piping - Standard, 2-band or 4-band shielded, stainless-steel couplings, CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - 3. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.

- a. Sanitary Sewer Piping - Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

B. Copper Tube And Fittings - Forced Main:

1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Tube and Fittings:

1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B88, Type K water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube and Fittings:

1. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
2. Wrought-Copper Solder-Joint Fittings: ASME B 16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Hubless Cast Iron Pipe and Fittings:

1. Pipe Fittings: ASTM A 888 or CISPI 301.
2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.
 - a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

2.7 STORM DRAINAGE PIPING, ABOVE GRADE

A. Hubless Cast Iron Pipe and Fittings:

1. Pipe Fittings: ASTM A 888 or CISPI 301.
2. Shielded Couplings: ASTM C 1540 assembly of metal shield or housing, corrosion-resistant fasteners and rubber sleeve with integral, center pipe stop.

- a. Heavy-Duty, 4-band shielded, stainless-steel couplings, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

2.8 ENCASEMENT FOR UNDERGROUND PIPING

- A. High density cross laminated polyethylene film intended for encasement of underground piping for protection against corrosion.
 1. ASTM 1674 or AWWA C105
 2. Minimum thickness: 0.004-inch
 3. Form: Tube
 4. Color: Natural

2.9 CONDENSATE PIPING

- A. Copper Tube And Fittings:
 1. Hard Drawn Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

2.10 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 4. Vertical Pipe Support: Steel riser clamp.
 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
- B. Plumbing Piping - Drain, Waste, and Vent:
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
 3. Wall Support for Pipe Sizes to 3 inch: Cast iron hook.
 4. Wall Support for Pipe Sizes 4 inch and Over: Welded steel bracket and wrought steel clamp.
 5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 6. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- C. Plumbing Piping - Water:
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
 2. Hangers for Cold Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
 3. Hangers for Hot Pipe Sizes 2 to 4 inch: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes 6 inch and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
 5. Wall Support for Pipe Sizes Up to 3 inch: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 inch and Larger: Welded steel bracket and wrought steel clamp.
 7. Wall Support for Hot Pipe Sizes 6 inch and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
 8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Floor Support for Hot Pipe Sizes to 4 inch: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
 10. Floor Support for Hot Pipe Sizes 6 inch and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
 11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated, plastic-coated, or felt-lined for non-insulated copper pipe.
- D. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
1. Concrete Wedge Expansion Anchors: Comply with ICC-ES AC193.
 2. Masonry Wedge Expansion Anchors: Comply with ICC-ES AC01.
 3. Concrete Screw Type Anchors: Comply with ICC-ES AC193.
 4. Masonry Screw Type Anchors: Comply with ICC-ES AC106.

2.11 BRONZE GATE VALVES

- A. Bronze Gate Valve, General: MSS SP-80, with ferrous-alloy handwheel.
- B. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

2.12 BRONZE GLOBE VALVES

- A. Bronze Globe Valve, General: MSS SP-80, with ferrous-alloy handwheel.
- B. Type 1, Class 200, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.
- C. Type 2, Class 200, Bronze Gate Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

2.13 BALL VALVES

- A. General Duty: Copper-Alloy Ball Valves:
 1. Copper-Alloy Ball Valves, General: MSS SP-110
 2. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full-port, chrome-plated bronze ball, PTFE or TFE seats, and 600 psig (4140 kPa) minimum CWP rating and blowout-proof stem.
 3. Threaded end connection for NPS 2 inch and smaller.

4. Flanged end connection for NPS 2-1/2 inch and larger.
- B. General Duty: Ferrous-Alloy Ball Valves:
1. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flange ends.
 2. Ferrous-Alloy Ball Valves: Class 300, full or regular port.
 3. Threaded end connection for NPS 2 inch and smaller.
 4. Flanged end connection for NPS 2-1/2 inch and larger.
- C. Gas Service: Bronze Ball Valves, NPS 2 inch and smaller:
1. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze, blowout proof.
 5. Seats: Reinforced TFE, blowout proof.
 6. Ends: Threaded, NPS 2 inch and smaller.
 7. CWP Rating: 600 psig (4140 kPa).
 8. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 9. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Gas Service: PE Ball Valve, complying with ASME B16.40.
1. Body: PE
 2. Ball: PE
 3. Stem: Acetal.
 4. Seats and Seals: Nitrile.
 5. Ends: Plain or fusible to match piping.
 6. CWP Rating: 80 psig (552 kPa).
 7. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
 8. Operator: Nut or flat head for key operation.
 9. Include plastic valve extension.
 10. Include tamperproof locking feature for valves where indicated on Drawings.
 11. Service for underground.

2.14 PLUG VALVES

- A. General Duty: Cast-Iron Plug Valves:
1. Cast-Iron Plug Valves, General: MSS SP-78.
 2. Class 250 or 300, lubricated-type, cast-iron plug valves.
 3. Class 250, nonlubricated-type, cast-iron plug valves.
- B. Gas Service: Bronze Plug Valves: MSS SP-78, NPS 2-1/2 inch and larger.
1. Body: Bronze, complying with ASTM B 584.
 2. Plug: Bronze.
 3. Ends: Threaded, socket, or flanged.

4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig (862 kPa).
6. Listing: Valves NPS 1 inch and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service for aboveground: Suitable for natural-gas service with "WOG" indicated on valve body.

2.15 FERROUS-ALLOY BUTTERFLY VALVES

- A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
- B. Flangeless, 250-psig (1725 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer type with one or two piece stem.
- C. Single-Flange, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Wafer-lug type with one or two piece stem.
- D. Flanged, 300-psig (2070 kPa) CWP Rating, Ferrous-Alloy Butterfly Valve: Flanged-end type with one or two piece stem

2.16 SPRING LOADED, LIFT-DISC CHECK VALVES

- A. Lift-Disc Check Valves, General: FCI 74-1, with spring-loaded bronze or alloy disc and bronze or alloy seat.
- B. Type II, Class 250, Compact Wafer, Lift-Disc Check Valves: Compact-wafer style with cast-iron shell with diameter made to fit within bolt circle.
- C. Type III, Class 250, Globe Lift-Disc Check Valves: Globe Style with cast iron shell and flanged ends.
- D. Type IV, Class 150, Threaded Lift-Disc Check Valves: Threaded style with bronze shell and threaded ends.

2.17 PRESSURE REDUCING VALVES

- A. 2 inch and Smaller:
 1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.
 2. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 5 to 50 psi.
 - b. Connected into brass or bronze pilot piping and fittings.
 - c. Fixed flow restrictor, pressure gauges, and isolation valves.
- B. 2 inch and Larger:

1. ASSE 1003, cast iron body with interior lining complying with AWWA C550, bronze fitted, elastomeric diaphragm and seat disc, flanged.
2. Pressure Reducing Pilot-Operator:
 - a. Operating Range: 5 to 50 psi.
 - b. Connected into brass or bronze pilot piping and fittings.
 - c. Fixed flow restrictor, strainer, pressure gauges, and isolation valves.

2.18 PRESSURE RELIEF VALVES

- A. ANSI Z21.22, AGA certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

2.19 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
 1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
 2. Body: Bronze for NPS 2 inch and smaller. Cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating for NPS 2-1/2 inch and larger.
 3. End Connections: Threaded for NPS 2 inch and smaller. Flanged for NPS 2-1/2 inch and larger.
 4. Screen: Stainless steel with round perforations, unless otherwise noted.
 5. Perforation Size:
 - a. Strainers NPS 2 inch and Smaller: 0.062 inch (157 mm)
 - b. Strainers NPS 2-1/2 inch to NPS 4 inch: 0.125 inch (3.18 mm).
 - c. Strainers NPS 5 inch and Larger: 0.25 inch (6.35 mm)
 6. Drain: Factory-installed, hose-end drain valve.

2.20 BALANCING VALVES

- A. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Memory-Stop Balancing Valves:
 1. Standard: MSS SP-110 for two-piece copper alloy ball valve or MSS SP-80 for bronze straight pattern globe valves.
 2. Pressure Rating: 125 psig minimum CWP.
 3. Size: NPS 2 inch or smaller.
 4. Body: Copper Alloy or Brass.
 5. Ports: Standard or full test ports for differential pressure measurement.
 6. Seats and Seals: Replaceable.
 7. End Connections: Threaded.
 8. Handle: Vinyl-covered steel or heavy duty plastic with memory-setting device.

2.21 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3 inch, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome Plated.

B. Pressure Vacuum Breakers:

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure Applications.
3. Accessories:
 - a. Valves: Ball Type, on inlet and outlet.

2.22 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Operating-Pressure Rating: 0.5 psig.
5. End Fittings: Zinc-coated steel.
6. Threaded Ends: Comply with ASME B1.20.1.
7. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig

C. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
 4. CWP Rating: 750 psig
- E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 TRENCHING FOR UNDERGROUND PIPING

- A. Comply with requirements of Division 31.
- B. Comply with recommendations of available geotechnical report
- C. Installation and Construction: Trench excavation shall comply with AST D2321.
1. Fill material shall be free of roots, rocks, debris, and organic materials. Fill material shall swell less than 3% when compacted.
 2. Sand bedding material shall be natural river or bank sand free of silt, clay, loam, friable or soluble materials, and organic materials. Graded in accordance with ANSI/ASTM C136.
 3. Trench backfill in layers.
 4. Compact bedding before placing pipe.
 5. Hand place fill material to six inches above top of pipe and compact fill without damaging piping.
 6. Remainder of fill may be placed in trench by gravity from height not exceeding 12-inches above trench.

3.4 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide access where valves and fittings are not exposed.
- I. Establish elevations of buried piping outside the building to ensure not less than 2 ft of cover.
- J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly;
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- L. Provide support for utility meters in accordance with requirements of utility companies.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
- N. Excavate in accordance with Section 312316.
- O. Install bell and spigot pipe with bell end upstream.
- P. Install valves with stems upright or horizontal, not inverted. See Section 220523.
- Q. Install water piping to ASME B31.9.
- R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- S. Sleeve pipes passing through partitions, walls, and floors.
- T. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

U. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as indicated.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.
11. Support cast iron drainage piping at every joint.

3.5 APPLICATION

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- D. Install gate valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- E. Install globe valves for throttling, bypass, or manual flow control services.
- F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.
- G. Provide spring-loaded check valves on discharge of water pumps.
- H. Provide flow controls in water recirculating systems where indicated.

3.6 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.
- B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfect water distribution system in accordance with Division 31.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.
- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.8 SERVICE CONNECTIONS

- A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.
 - 1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
 - 2. Provide 18 gauge, 0.0478-inch galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.9 SCHEDULES

- A. Pipe Hanger Spacing:
 - 1. Metal Piping:
 - a. Pipe Size: 1/2 inch to 1-1/4 inch:
 - 1) Maximum Hanger Spacing: 6.5 ft.

- 2) Hanger Rod Diameter: 3/8 inches.
 - b. Pipe Size: 1-1/2 inch to 2 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.
 - c. Pipe Size: 2-1/2 inch to 3 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 1/2 inch.
 - d. Pipe Size: 4 inch to 6 inch:
 - 1) Maximum Hanger Spacing: 10 ft.
 - 2) Hanger Rod Diameter: 5/8 inch.
 - e. Pipe Size: 8 inch to 12 inch:
 - 1) Maximum hanger spacing: 14 ft.
 - 2) Hanger Rod Diameter: 7/8 inch.
 - f. Pipe Size: 14 inch and Over:
 - 1) Maximum Hanger Spacing: 20 ft.
 - 2) Hanger Rod Diameter: 1 inch.
2. Plastic Piping:
- a. All Sizes:
 - 1) Maximum Hanger Spacing: 6 ft.
 - 2) Hanger Rod Diameter: 3/8 inch.

END OF SECTION 221005

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SECTION 221006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Refrigerator valve and recessed box.
- E. Water hammer arrestors.
- F. Mixing valves.

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.
- B. Section 224000 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

- A. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003.
- C. ASSE 1011 - Hose Connection Vacuum Breakers; 2004.
- D. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; 2009.
- E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- F. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- H. PDI-WH 201 - Water Hammer Arresters; 2010.
- I. NSF 61, "Drinking Water System Components."
- J. California Health & Safety Code 116875 for lead free content.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- D. Operation Data: Indicate frequency of treatment required for interceptors.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
 - 2. Josam Company: www.josam.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Roof and Overflow Drains:
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Removable cast iron dome with vandal proof screws.
 - 4. Accessories: Coordinate with roofing type.
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Adjustable under deck clamp.
 - c. Roof sump receiver.
 - d. Waterproofing flange.
 - e. Controlled flow weir.
 - f. Leveling frame.
 - g. Adjustable extension sleeve for roof insulation.
- C. Canopy and Cornice Drains:
 - 1. Lacquered cast iron body with aluminum flashing clamp collar and epoxy coated flat strainer.
- D. Downspout Nozzles:

1. Bronze round with straight bottom section.

E. Area Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Round nickel-bronze.
4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp.

F. Floor Drain:

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

G. Floor Drain (FD-2):

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and square, adjustable nickel-bronze strainer.

H. Floor Sink:

1. Lacquered cast iron body with dome strainer and seepage flange.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts :

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. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation
2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts :

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. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
3. Size: Same as connected branch.
4. Type: Cast-iron soil pipe with cast-iron ferrule.

5. Body or Ferrule:
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts :

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. Watts Drainage Products Inc.
 - c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

- B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch- (1.6-mm-) thick, lead flashing collar and skirt extending at least 6 inches (150 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.5 VANDAL-PROOF VENT CAPS

- A. Description: Low-silhouette vandal-proof hooded vent cap for roof terminations of sanitary vent lines.
 - 1. Cast iron body.
 - 2. Vandal-proof securing device.
- B. Provide vandal-proof vent caps at all roof vent terminations.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
 - 1. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
 - 2. Size: Same as connected soil, waste, or vent stack.
 - 3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
 - 4. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
 - 5. Special Coating: Corrosion resistant on interior of fittings

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Floor-Drain, Trap-Seal Primer Fittings :
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.
- B. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- C. Sleeve Flashing Device :
 - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
- D. Stack Flashing Fittings :

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps :

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.8 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic

2.9 HOSE BIBBS

- A. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.

2.10 REFRIGERATOR VALVE AND RECESSED BOX

- A. Description: Plastic preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.11 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventers:
1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.12 DOUBLE CHECK VALVE ASSEMBLIES

A. Double Check Valve Assemblies:

1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

2.13 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jayrsmith.com/#sle.
2. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.14 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Valve: Chrome plated cast brass or glass-filled polysulfone body, stainless steel or copper alloy bellows or thermoplastic polymer cartridge, with integral temperature adjustment.
2. Quality Assurance
 - a. Maximum Working Pressure: 125 psig (860 kPa), unless otherwise indicated.
 - b. Comply with NSF 61, "Drinking Water System Components."
 - c. Comply with California Health & Safety Code 116875 for lead free content.
3. Accessories:
 - a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.
 - c. Strainer stop checks on inlets.
4. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

B. Pressure Balanced Mixing Valves:

1. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.
2. Accessories:
 - a. Volume control shut-off valve on outlet.
 - b. Strainer stop checks on inlets.
3. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories sinks and washing machine outlets .

END OF SECTION 221006

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters:
 - 1. Commerical heat pump, tank-type
- B. In-line circulator pumps.

1.2 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less; 2011.
- B. ANSI Z21.10.3 - Gas-Fired Water Heaters - Volume III - Storage Water Heaters with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous; 2015.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
- D. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.
- E. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.
- F. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.
 - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 - 4. Provide electrical characteristics and connection requirements.

- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
 - 1. Water Heaters: NSF approved.
 - 2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable.
 - 3. Gas Water Heaters: Comply with SCAQMD Rule 1146.2 requirements for ultra low-NOx emissions.
 - 4. Electric Water Heaters: UL listed and labeled to UL 174.
 - 5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
 - 6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for domestic water heaters.
- C. Provide five year manufacturer warranty for booster pumps, sewage ejectors, and sump pumps.

PART 2 PRODUCTS

2.1 WATER HEATERS

PLUMBING EQUIPMENT

- A. Manufacturers:
 - 1. A.O. Smith Water Products Co: www.hotwater.com/#sle.
 - 2. Bock Water Heaters, Inc: www.bockwaterheaters.com/#sle.
 - 3. Rheem Manufacturing Company: www.rheem.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Commercial Heat Pump, Tank-type:
 - 1. Type: Factory-assembled and wired, electric heat pump, vertical storage.
 - 2. Performance: Refer to Drawings
 - 3. Electrical Characteristics: Refer to Drawings
 - 4. Accessories:
 - a. Water Connections: Brass.
 - b. Drain valve.
 - c. Temperature and Pressure Relief Valve: ASME labeled.
 - 5. Temperature Range: 90-180°F.
 - 6. Operating ambient temperature range: 40-110° F
 - 7. Refrigerant: R-134a
 - 8. Controls: LCD display with built-in diagnostic and troubleshooting information. Multiple operating modes: "Efficiency, Hybrid or Electric"
 - 9. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch glass fiber; enclosed with 16 gage, 0.0598 inch steel jacket; baked enamel finish.

2.2 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a xylem brand: www.bellgossett.com/#sle.
 - 3. Grundfos
 - 4. Taco
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Casing: Bronze or Cast Iron, rated for 125 psig working pressure.
- C. Impeller: Bronze or Composite.
- D. Shaft: Steel or ceramic.
- E. Motor: Integral to pump.
- F. Performance: Refer to Drawings.

2.3 COOLING CONDENSATE REMOVAL PUMPS

- A. Manufacturers:

1. Aspen Pumps
 2. Little Giant / Franklin Electric
 3. Zoeller Company: www.zoeller.com
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.
- C. Safety: UL 778.
- D. Performance: Refer to Drawings

2.4 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Pumps:
1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
 3. Align and verify alignment of base mounted pumps prior to start-up
 4. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

3.2 SCHEDULES

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A. Refer to Drawings.

END OF SECTION 223000

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SECTION 224000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water closets.
- B. Urinals.
- C. Lavatories.
- D. Sinks.
- E. Service sinks.
- F. Electric water coolers.
- G. Hose Bibbs
- H. Icemaker Supply Boxes
- I. Trap Primers
- J. Water Hammer Arrestors
- K. Thermostatic Mixing Valves

1.2 RELATED REQUIREMENTS

- A. Section 221005 - Plumbing Piping.
- B. Section 221006 - Plumbing Piping Specialties.
- C. Section 223000 - Plumbing Equipment.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.18.1 - Plumbing Supply Fittings; 2012.
- C. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2013.
- D. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 2008 (R2011).
- E. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2011.

- F. NSF 61 - Drinking Water System Components - Health Effects; 2023.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- H. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- C. Accessible Plumbing Fixtures:
 - 1. Accessible Plumbing Fixtures, plumbing fixtures intended for people with disabilities, shall comply with requirements contained in:
 - a. ICC A117.1, "Accessible and Usable Buildings and Facilities"
 - b. Public Law 90-480, "Architectural Barriers Act"
 - c. Public Law 101-336, "Americans with Disabilities Act"
 - 2. Plumbing fixtures and accessories in toilet rooms shall comply with CBC Section 11B-213.2 and Section 11B-213.3.
 - 3. Accessible plumbing fixtures shall comply with all requirements of CBC Section 11B, Division 6.
 - a. Clearance around accesible water closets shall be minimum 60 inches measured perpendicular from side wall and 56 inches measured perpendicular from rear wall per CBC Section 11B-604.3.1
 - b. Heights and location of accessible plumbing fixtures shall comply with CBC Sections 11B-602 through 11B-612.
 - c. Fixture controls for accessible plumbing fixtures shall comply with the following:
 - 1) CBC Section 11B-602.3 for drinking fountains
 - 2) CBC Section 11B-604.6 for water closets

- 3) CBC Section 11B-604.9.5 for children's water closets
 - 4) CBC Section 11B-605.4 for urinals
 - 5) CBC Section 11B-606.4 for lavatories and sinks
 - 6) CBC Section 11B-607.5 for bath tubs
 - 7) CBC Section 11B-608.5 for showers
 - 8) CBC Section 11B-611.3 for washing machines and clothes dryers
4. Accessible sinks shall be mounted with the front of the counter or rim no higher and 34" above the finished floor.
 5. Depth of lavatories or sinks shall not interfere with knee or toe clearance provided in accordance with CBC Section 11B-306 when a forward approach is required.
 6. 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. Refer to CBC Section 11B-605.5.
 7. Accessible sinks shall be a maximum of 6-1/2" deep.
 8. Heights and location of plumbing fixtures shall comply with DSA Checklist Figure 15-A.
- D. Plumbing Fixture Water Flow Rates:
1. Comply with requirements in Public Law 102-486, "Energy Policy Act," regarding water flow and consumption rates for plumbing fixtures.
 2. Comply with requirements of California CCF Title 24, Part 11 "California Green Building Standards", Section 5.303 Indoor Water Use, regarding plumbing fixture maximum flow rates.
- E. NSF Standards: Comply with NSF 61, "Drinking Water System Components--Health Effects," and NSF 372 "Lead Content Compliance" for fixture materials that will be in contact with potable water. Provide pipe and fittings with NSF certification marks demonstrating compliance.
- F. Lead Content Restrictions: Domestic water piping, valves, and components shall conform to California AB 1953 Legislation as applicable for maximum allowable lead content.
- G. Gender Neutral Restrooms: All single-user restrooms shall be designated as gender neutral facilities by a door symbol and signage that complies with CBC Section 11B-216.8 and 11B-703.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.1 GENERAL

- A. Refer to schedules in Plumbing drawings for plumbing fixture specifications and additional information.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers or wall supports and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant. Color to match fixture.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

3.8 SCHEDULES

- A. Refer to Drawings.
- B. Fixture Heights: Install fixtures to heights above finished floor as indicated.
 - 1. Water Closet:
 - a. Standard: 15 inches to top of bowl rim.
 - b. Accessible: 18 inches to top of seat.
 - 2. Water Closet Flush Valves:
 - a. Standard: 11 inches min. above bowl rim.
 - b. Recessed: 10 inches min. above bowl rim.
 - 3. Urinal:
 - a. Standard: 22 inches to top of bowl rim.
 - b. Accessible: 17 inches to top of bowl rim.
 - 4. Lavatory:
 - a. Standard: 31 inches to top of basin rim.
 - b. Accessible: 34 inches to top of basin rim.
 - 5. Drinking Fountain:
 - a. Child: 30 inches to top of basin rim.
 - b. Standard Adult: 40 inches to top of basin rim.
 - c. Accessible: 36 inches to top of spout.

END OF SECTION 224000

DIVISION 23

HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping tube and fitting materials.
 - 2. Pipe joining materials.
 - 3. Transition fittings.
 - 4. Dielectric fittings.
 - 5. Mechanical sleeve seals.
 - 6. Sleeves.
 - 7. Escutcheons.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, 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 plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For the following:
 1. Transition fittings.
 2. Escutcheons.
- B. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) 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 (3.2 mm) 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, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- 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. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Refer to individual Division 22 piping Sections for dielectric fittings not listed below.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Reinforced Nylon Polymer or Stainless steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Steel with corrosion inhibiting coating or stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms for concrete foundation walls below grade.
- F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw. Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw. Polished chrome-plated and rough brass.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 ESCUTCHEONS

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
- g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
- h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

3.2 PENETRATIONS AND SLEEVES

- A. Sleeves are not required for core-drilled holes.
- B. Permanent sleeves are not required for holes formed by removable PE sleeves.
- C. 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. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 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 Section "Sheet Metal Flashing and Trim" for flashing.
 - d. Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- D. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

- F. Verify final equipment locations for roughing-in.
- G. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Grease fittings shall be installed in accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic requirements as indicated in the California Building Code.
 - 1. Construct concrete bases of dimensions indicated, but not less than 6 inches larger in both directions than supported unit, vibration isolator, or seismic restraint. Verify requirements with equipment anchor bolt edge distances.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section; unless otherwise indicated in structural drawings.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
- C. Seismic restraint systems.
- D. Vibration-isolated and/or seismically engineered roof curbs.

1.2 DEFINITIONS

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- E. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
- C. Shop Drawings - Vibration Isolation Systems:
 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 1. Select vibration isolators to provide required static deflection.
 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.

2.2 SEISMIC RESTRAINT SYSTEMS

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Cable Restraints:
 - 1. Comply with ASCE 19.
 - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut) for structural element; suitable for both compressive and tensile design loads.

2.3 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS

- A. Seismic Type:
 - 1. Non-isolated Curb and Fabricated Equipment Piers:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Steel.
 - c. Weather exposed components consist of corrosion resistant materials.
 - 2. Vibration Isolation Curb:
 - a. Location: Between structure and rooftop equipment.
 - b. Construction: Steel.
 - c. Integral vibration isolation to conform to requirements of this section.
 - d. Snubbers consist of minimum 0.25 inch thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
 - e. Weather exposed components consist of corrosion resistant materials.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
 - 1. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.

2. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
3. Adjust isolators to be free of isolation short circuits during normal operation.
4. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
 1. Refer to Drawings.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Duct markers.
- D. Pipe markers.
- E. Ceiling tacks.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.3 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Product Data: Provide manufacturers catalog literature for each product required.
- E. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Nameplates.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.

- E. Ductwork: Duct Markers.
- F. Instrumentation: Tags.
- G. Major Control Components: Nameplates.
- H. Piping: Pipe markers.
- I. Relays: Tags.
- J. Small-sized Equipment: Tags.
- K. Thermostats: Adhesive backed label.

2.2 NAMEPLATES

- A. Content: Minimum information indicating unique equipment tag.
- B. Multi-layered metalized polyester with permanent adhesive.
 - 1. Letter Color: White.
 - 2. Letter Height: 2 inch, minimum.
 - 3. Background Color: Black.
 - 4. Plastic: Comply with ASTM D709.

2.3 TAGS

- A. Content: Minimum information indicating unique valve or instrument tag
- B. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.4 DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film; printed with UV and chemical resistant inks.
- B. Style: Multiple Markers on a Roll.
- C. Content: Minimum information indicating flow direction arrow and identification of air service.
- D. Color: Yellow/Black for concealed ductwork.
- E. Size: 12 inch long color field (minimum), 2-1/2 inch high letters.

2.5 PIPE MARKERS

- A. Color: Comply with ASME A13.1.

- B. Content: Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Size:
 - 1. Up to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
 - 2. Over 2 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
- D. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
- E. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

2.6 CEILING TACKS

- A. Manufacturers:
 - 1. Craftmark Pipe Markers; _____: www.craftmarkid.com/#sle.
- B. Description: Steel with 3/4 inch diameter color coded head.
- C. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install valve tags with corrosion resistant chain.
- C. Install plastic pipe markers or plastic tape pipe markers in accordance with manufacturer's instructions.
- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

- E. Install ductwork with duct labels.
- F. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.

1.2 SUBMITTALS

- A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit to Architect.
 - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
 - 3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
 - 4. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.
 - f. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - g. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
 - h. Confirmation of understanding of the outside air ventilation criteria under all conditions.
 - i. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
 - j. Method of checking building static and exhaust fan and/or relief damper capacity.
 - k. Procedures for formal deficiency reports, including scope, frequency and distribution.

- B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.
 10. Air outlets are installed and connected.
 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

- N. For variable air volume system powered units set volume controller to air flow setting indicated.
Confirm connections properly made and confirm proper operation for automatic variable air
volume temperature control.

END OF SECTION 230593

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SECTION 230713 - HVAC DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Jacketing and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- G. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).
- H. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2022a, with Editorial Revision (2023).
- K. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- L. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.

- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- N. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- O. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, UL 723, ASTM E84, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value (maximum): 0.29 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Density: 0.75 lbs/cu. ft. (nominal)
 - 3. Maximum Service Temperature: 1,200 degrees F.
 - 4. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film ('FSK') or White kraft paper with glass fiber yarn ('PSK').
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Outdoor Vapor Barrier Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

2.3 GLASS FIBER, RIGID

- A. Manufacturer:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville: www.jm.com.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. K Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Absorption: 5.0 percent.
 - 4. Maximum Density: 8.0 pcf.

- C. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 - 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.4 JACKETING AND ACCESSORIES

- A. Aluminum Jacket:
 - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
 - 2. Thickness: 0.016 inch sheet.
 - 3. Finish: Embossed.
 - 4. Joining: Longitudinal slip joints and 2 inch laps.
 - 5. Fittings: 0.016 inch thick die-shaped fitting covers with factory-attached protective liner.
 - 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- B. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723 or ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch, when tested in accordance with ASTM E96/E96M.
 - 4. Finish: Match insulation.
- C. UL181 Tape for Rigid and Flexible Ductwork:
 - 1. Comply with UL 181A for rigid ductwork.
 - 2. Comply with UL 181B for flexible ductwork.
 - 3. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
 - 4. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.

2.5 DUCT LINER

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.

2. Ductmate Industries, Inc, a DMI Company; PolyArmor (Basis of Design):
www.ductmate.com/#sle.
 3. Johns Manville: www.jm.com/#sle.
 4. Knauf Insulation: www.knaufinsulation.com/#sle.
- B. Insulation: Non-corrosive, incombustible polyester fiber complying with ASTM C1071 and ASTM E84; webbed into a thermal blanket which is then bonded with a FSK Facing.
1. Fungal Resistance: No growth when tested according to ASTM G21.
 2. Thermal Resistance at 75 degrees F per ASTM C518:
 - a. 1-inch Thickness: R-4.2
 - b. 1-1/4 inch Thickness: R-5
 - c. 1-1/2 inch Thickness: R-6
 - d. 2-inch Thickness: R-8
 3. Service Temperature: Up to 250 degrees F.
 4. Rated Velocity on Coated Air Side for Air Erosion: 4000 fpm.
 5. Minimum Noise Reduction Coefficients:
 - a. 1 inch Thickness: 0.65.
 - b. 1-1/4 inch Thickness: 0.65
 - c. 1-1/2 inches Thickness: 0.65.
 - d. 2 inch Thickness: 0.65.
- C. Adhesive: Waterproof, fire-retardant type, ASTM C916.
- D. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 1. Provide insulation with vapor barrier jackets.
 2. Finish with tape and vapor barrier jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces (below 10 feet above finished floor): Finish with aluminum jacket.
- F. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with aluminum jacket.
- G. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.
 - 3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
 - 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 90 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

- A. Refer to Drawings for Duct Insulation Schedule.

END OF SECTION 230713

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. See Section 019113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 019113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
 - 1. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).

1.3 SUBMITTALS

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- C. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
 - 1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.

2. Full as-built set of control drawings.
 3. Full as-built sequence of operations for each piece of equipment.
 4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
 - a. Floor.
 - b. Room number.
 - c. Room name.
 - d. Air handler unit ID.
 - e. Reference drawing number.
 - f. Air terminal unit tag ID.
 - g. Minimum air flow rate.
 - h. Maximum air flow rate.
 5. Full print out of all schedules and set points after testing and acceptance of the system.
 6. Full as-built print out of software program.
 7. Electronic copy on disk of the entire program for this facility.
 8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
 9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
 10. Control equipment component submittals, parts lists, etc.
 11. Warranty requirements.
 12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
 13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
 - a. Sequences of operation.
 - b. Control drawings.
 - c. Points lists.
 - d. Controller and/or module data.
 - e. Thermostats and timers.
 - f. Sensors and DP switches.
 - g. Dampers and damper actuators.
 - h. Program setups (software program printouts).
- D. Project Record Documents: See Section 017800 for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
 2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- E. Draft Training Plan: In addition to requirements specified in Section 017900, include:
1. Follow the recommendations of ASHRAE Guideline 1.1.
 2. Control system manufacturer's recommended training.

3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- F. Training Manuals: See Section 017900 for additional requirements.
 1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

- G. Provide temperature and pressure taps in accordance with Contract Documents.

3.2 INSPECTING AND TESTING - GENERAL

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
 - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 - 2. Set pump/fan to normal operating mode.
 - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
 - 5. Command valve/damper to a few intermediate positions.
 - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.3 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.

- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.4 CONTROL SYSTEM FUNCTIONAL TESTING

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
 - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
 - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
 - 1. Setpoint changing features and functions.
 - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
 - 1. That all specified functions and features are set up, debugged and fully operable.
 - 2. That scheduling features are fully functional and setup, including holidays.
 - 3. That all graphic screens and value readouts are completed.
 - 4. Correct date and time setting in central computer.
 - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.

6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
 7. Power failure and battery backup and power-up restart functions.
 8. Global commands features.
 9. Security and access codes.
 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
 11. O&M schedules and alarms.
 12. Occupancy sensors and controls.
 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.6 DEMONSTRATION AND TRAINING

- A. See Section 017900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:

- E. TAB Review: Instruct Owner's personnel for minimum 5 hours, after completion of TAB, on the following:
1. Review final TAB report, explaining the layout and meanings of each data type.
 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
1. Phase 1 - Basic Control System: Provide minimum of 20 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
 - a. This training may be held on-site or at the manufacturer's facility.
 - b. If held off-site, the training may occur prior to final completion of the system installation.
 - c. For off-site training, Contractor shall pay expenses of up to two attendees.
 2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 20 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
 - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
 - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
 - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
 - d. Every display screen, allowing time for questions.
 - e. Point database entry and modifications.
 3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 3 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.

- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION 230800

SECTION 230913 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Energy Metering:
 - 1. Hydronic energy meters.
- B. Control Panels
- C. Dampers.
- D. Zone Temperature Sensors
- E. Input/Output Sensors
- F. Line-voltage Thermostats
- G. Operable Window Status Sensors
- H. Thermal Energy Meters.
- I. Transmitters
- J. User Override Switch

1.2 REFERENCE STANDARDS

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

- D. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum _____ years experience with minimum 5 years experience.

PART 2 PRODUCTS

2.1 EQUIPMENT - GENERAL

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

2.2 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA Standard 250 general purpose utility enclosures with enamelled finished face panel.
Select control panel type appropriate for panel application and installed location:
 - 1. Type 1 for Indoor Nonhazardous Locations
 - 2. Type 4 for Outdoor Nonhazardous Locations
- C. Provide common keying for all panels.

2.3 DAMPERS

- A. HVAC Dampers:

2.4 DAMPER OPERATORS

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and provide tight seal against maximum system pressures. Provide spring return for two-position control and for fail-safe operation.
 - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.

2. Provide one operator for maximum 36 sq ft damper section.
3. Adjustable stroke motor having oil immersed gear train, with auxiliary end switch.
4. Operator to be controlled at 120 V. Coordinate with electrical.

2.5 ZONE TEMPERATURE SENSORS

A. Zone Temperature Sensors without User Interface

1. Wall-mounted zone temperature sensor for measuring zone temperature and providing input to Direct Digital Control System for HVAC.
 - a. Refer to Section 230923
 - b. Stainless steel button
 - c. Basis of Design: Kele KTB Series
2. Temperature Sensors:
 - a. Accurate within 0.5 degree F with linear output.
 - b. Range of 0 to 120 degree F
3. Power requirement: None
4. Mounting: Flush mount to standard 4"x2" electrical box.

B. Zone Temperature Sensors with User Interface

1. Wall-mounted zone temperature sensor for measuring zone temperature and providing input to Direct Digital Control System for HVAC.
 - a. Refer to Section 230923
 - b. Provide zone temperature sensors by DDC system manufacturer.
 - c. Basis of Design: **Automated Logic RS Pro**
2. Temperature Sensors:
 - a. Accurate within 0.5 degree F with linear output.
 - b. Range of 0 to 120 degree F
3. Power requirement: 12 VDC
4. Communication: 115 kbps R-net connection between sensor(s) and controller.
5. Local access communications port
6. Mounting: Mount to standard 4"x2" electrical box.
7. Display: LCD to displays zone temperature, outside air temperature, zone heating and cooling setpoints.
8. Occupant Override: Zone setpoint adjustment and override feature integral to controller.

2.6 HVAC&R SENSORS

A. Temperature Sensors:

1. Applications
 - a. Wall-mounted temperature sensors: Stainless steel flatplate mount to standard 4"x2" electrical box.
 - b. Air-stream temperature sensors: With galvanized enclosure. 10 kOhm sensing element. 29 cm probe.

- c. Immersion temperature sensors: With galvanized enclosure. 10 kOhm sensing element. 10 cm probe.
- 2. Types:
 - a. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
 - b. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
 - c. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
- 3. Temperature Sensing Device: Compatible with project DDC controllers.
- 4. Performance Characteristics:
 - a. RTD:
 - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F minimum.
 - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F minimum.
 - 3) All Other Accuracy: Plus/minus 0.75 degrees F minimum.
 - 4) Range: Minus 40 degrees F through 220 degrees F minimum.
 - b. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Range: Minus 25 degrees F through 122 degrees F minimum.
 - 3) Heat Dissipation Constant: 2.7 mW per degree C.
 - c. Temperature Transmitter:
 - 1) Accuracy: 0.10 degree F minimum or plus/minus 0.20 percent of span.
 - 2) Output: 4 to 20 mA.
 - d. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 to 230 degrees F.
 - 3) Use temperature transmitters in conjunction with RTD's when RTD's are incompatible with DDC controller direct temperature input.
 - e. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
 - f. Temperature Averaging Elements:
 - 1) Use on duct sensors for ductwork 10 sq ft or larger.

- 2) Use averaging elements where prone to stratification with sensor length 8 ft or 16 ft.
- 3) Provide for all mixed air and heating coil discharge sensors regardless of duct size.
- g. Insertion Elements:
 - 1) Use in ducts not affected by temperature stratification or smaller than 11 sq inches.
 - 2) Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches.
- B. Static Pressure (Air Pressure) Sensors:
 1. Manufacturers:
 - a. Veris Industries; _____: www.veris.com/#sle.
 2. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
 3. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
 4. Accuracy: One percent of full scale with repeatability 0.3 percent.
 5. Output: 0 to 5 vdc with power at 12 to 28 vdc.
- C. Damper Position Indication:
 1. Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

2.7 OPERABLE WINDOW STATUS SENSORS:

- A. Recessed, press-fit magentic contact switch to be provided with operable windows.
 1. Sensor to provide binary input based on 0-10 VDC or 4-20 mA from control system.
 2. Refer to Section 084000.

2.8 SENSORS WITH TRANSMITTERS

- A. Building Static Pressure Transmitters:
 1. One pipe, direct acting, double bell, scale range 0.01 to 0.25 inch wg positive or negative, and sensitivity of 0.05 inch wg. Transmit electronic signal to receiver with matching scale range.
- B. Duct Pressure Transmitters:
 1. One pipe direct acting for HVAC supply air service, range suitable for system, proportional electronic output.

2.9 ENERGY METERING

- A. Hydronic Energy Meters:
 - 1. Manufacturers:
 - 2. Provide Btu/h meter with wall-mounted hardware capable of being installed remotely from the flow meter.
 - 3. Include LCD display for local indication of energy rate including settings and parameters during configuration.
 - 4. Factory configure to the specific application with field configuration by the user via the front panel keypad without the requirement of a computer or special interface.
 - 5. Output to indicate energy rate, energy total, flow rate, and supply/return temperature.
 - 6. Integral transmitter to provide a linear analog or configurable pulse output signal representing the energy rate with the signal compatible with the building automation system DDC hardware to which the output is connected.

2.10 USER OVERRIDE SWITCH

- A. Wall-mounted, push button switch for manual override signal to Direct Digital Control System.
- B. Flush-mounted with stainless steel cover plate.
- C. Red colored button with LED illuminator.
 - 1. Basis of Design: IDEC Pushbutton Switch: AOW-110R
 - 2. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- F. Ensure installation of components is complementary to installation of similar components.
- G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches above floor. Align with lighting switches; see Section 262726.
- C. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide pilot positioners on mixed air damper motors.
- D. Provide isolation (two-position) dampers of parallel blade construction.
- E. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- F. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- H. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

3.3 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- C. Provide complete service of controls systems, including call backs, and submit written report of each service call.

END OF SECTION 230913

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SECTION 230923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System description.
- B. Operator interface.
- C. Controllers.
- D. Power supplies and line filtering.
- E. System software.
- F. Controller software.
- G. HVAC control programs.

1.2 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2022).
- B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.4 SUBMITTALS

- A. Product Data: Provide data for each system component and software module.
- B. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
 - 2. List connected data points, including connected control unit and input device.

3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
 5. Indicate description and sequence of operation of operating, user, and application software.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
1. Revise shop drawings to reflect actual installation and operating sequences.
 2. Include submittals data in final "Record Documents" form.
- E. Operation and Maintenance Data:
1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

1.7 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
 - 1. Limiting use of software to equipment provided under these specifications.
 - 2. Limiting copying.
 - 3. Preserving confidentiality.
 - 4. Prohibiting transfer to a third party.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Automated Logic
- B. Delta Controls;[____]: www.deltacontrols.com/#sle.
- C. Schneider Electric[<◇>]:
- D. Alerton
- E. Substitutions: See Section 016000 - Product Requirements.

2.2 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 230913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.3 OPERATOR INTERFACE

- A. PC Based Work Station:
- B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
- C. BACnet protocol to comply with ASHRAE Std 135.
- D. Hardware:
 - 1. Laptop:
 - a. Laptop(s) to be provided by DDC controls manufacturer.
 - b. Quantity: As indicated on the drawings.
 - c. Network Connection:
 - 1) Ethernet interface card.

2.4 CONTROLLERS

- A. Building Controllers:
 - 1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.
 - f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
 - 2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.

- 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- B. Custom Application Controller:
- 1. General:
 - a. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - b. Share data between networked, microprocessor based controllers.
 - c. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - d. Utilize real-time clock for scheduling.
 - e. Continuously check processor status and memory circuits for abnormal operation.
 - f. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - g. Communication with other network devices to be based on assigned protocol.
 - 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.

4. Provisions for Serviceability:
 - a. Diagnostic LED's for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.
- C. Application Specific Controllers:
1. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F.
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F.
 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

D. Input/Output Interface:

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
 - b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
9. System Object Capacity:

- a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
- b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.5 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
2. Limit connected loads to 80 percent of rated capacity.
3. Match DC power supply to current output and voltage requirements.
4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
7. Operational Ambient Conditions: 32 to 120 degrees F.
8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
9. Line voltage units UL recognized and CSA approved.

B. Power Line Filtering:

1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
2. Minimum surge protection attributes:
 - a. Dielectric strength of 1000 volts minimum.
 - b. Response time of 10 nanoseconds or less.
 - c. Transverse mode noise attenuation of 65 dB or greater.
 - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

2.6 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 60 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.

- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.7 SYSTEM SOFTWARE

- A. Operating System:
 - 1. Concurrent, multi-tasking capability.
 - 2. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - (a) Analog and binary values.
 - (b) Dynamic text.
 - (c) Static text.
 - (d) Animation files.
 - 3. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.
 - b. HTML graphics to support web browser compatible formats.
 - c. Capture or convert graphics from Designer.
- B. Workstation System Applications:
 - 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on hard disk.
 - b. Automatic update occurs upon change in any system panel.
 - c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Workstations.
 - 2) Printers.
 - 3) Modems.
 - 4) Network connections.
 - 5) Building management panels.
 - 6) Controllers.
 - b. Device failure is annunciated to the operator.
7. Alarm Processing:
 - a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
8. Alarm Messages:
 - a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
9. Configurable Alarm Reactions by Workstation and Time of Day:

- a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
10. Custom Trend Logs:
- a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
- a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
- a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.
 - 3) Custom Programs.
13. Reports and Logs:
- a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.

- d. Set to be printed on operator command or specific time(s).
- 14. Reports:
 - a. Standard:
 - 1) Objects with current values.
 - 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.
 - 4) Objects in manual or automatic alarm lockout.
 - 5) Objects in alarm lockout currently in alarm.
 - 6) Logs:
 - (a) Alarm History.
 - (b) System messages.
 - (c) System events.
 - (d) Trends.
 - b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.
 - d. Electrical, Fuel, and Weather:
 - 1) Electrical Meter(s):
 - (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
 - (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
 - 2) Fuel Meter(s):
 - (a) Monthly showing daily natural gas consumption for each meter.
 - (b) Annual summary showing monthly consumption for each meter.
 - 3) Weather:
 - (a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:

1. Provide editing software for each system application at PC workstation.
2. Downloaded application is executed at controller panel.
3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.
 - d. Set-points.
4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
 - 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
 - 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.

- 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.8 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 1. User access secured via user passwords and user names.
 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 3. User Log On/Log Off attempts are recorded.
 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- C. Object or Object Group Scheduling:
 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 2. Exception Schedules:
 - a. Based on any day of the year.
 - b. Defined up to one year in advance.
 - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
 3. Holiday or Special Schedules:
 - a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 1. Binary object is set to alarm based on the operator specified state.
 2. Analog object to have high/low alarm limits.
 3. All alarming is capable of being automatically and manually disabled.
 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
 - 1) Start programs.

- 2) Logged.
- 3) Custom messaging.
- 4) Graphical displays.
- 5) Dial out to workstation receivers via system protocol.

F. Demand Limiting:

1. Building power consumption monitored from signals generated by a pulse generator, mounted at the building power meter.
2. Demand limit controlled via load shedding or load restoration in a predetermined and predictive manner.
3. Demand Reduction Methods:
 - a. Supply air temperature reset.
 - b. Space temperature set-point reset.
 - c. Equipment off/on prioritization.
4. Relevant variables that influence demand limiting control are based on the power company methodology for computing demand charges.
5. Operator On-Line Changes Allowed:
 - a. Addition and deletion of loads controlled.
 - b. Changes in demand intervals.
 - c. Changes in demand limit for meter(s).
 - d. Maximum equipment shutoff time.
 - e. Minimum equipment shutoff time.
 - f. Select rotational or sequential shedding and restoring.
 - g. Shed/restore priority.
6. Information and Reports available Hourly, Daily, and Monthly:
 - a. Total electric consumption.
 - b. Peak demand.
 - c. Date and time of peak demand.
 - d. Daily peak demand.

G. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

H. Sequencing: Application software based upon specified sequences of operation in Section 230993.

I. PID Control Characteristics:

1. Direct or reverse action.
2. Anti-windup.
3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
4. User selectable controlled variable, set-point, and PED gains.

J. Staggered Start Application:

1. Prevents all controlled equipment from simultaneously restarting after power outage.
2. Order of equipment startup is user selectable.

K. Energy Calculations:

1. Accumulated instantaneous power or flow rates are converted to energy use data.
2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

L. Anti-Short Cycling:

1. All binary output objects protected from short-cycling.
2. Allows minimum on-time and off-time to be selected.

M. On-Off Control with Differential:

1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

N. Run-Time Totalization:

1. Totalize run-times for all binary input objects.
2. Provides operator with capability to assign high run-time alarm.

2.9 SEQUENCE OF OPERATIONS:

- A. As Indicated on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 230993.

- C. Provide with 120v AC, 15 amp power circuit to each programmable control unit.
- D. Provide conduit and electrical wiring in accordance with Section 260583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- E. Install all control wiring in conduit.
 - 1. Control wiring located within accessible ceiling plenums may be installed as plenum rated cable and suspended from structure with j-hooks.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.
- C. Provide basic operator training for 5 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time. Provide training on site.

3.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

3.5 MAINTENANCE

- A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

END OF SECTION 230923

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SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal ducts.
- B. Flexible ducts.

1.2 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. 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; 2023.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- F. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- I. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- J. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- K. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide data for duct materials.
- B. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.

- C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate per appropriate seal class, following SMACNA (LEAK).
- D. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.5 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated.
- C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 233319.
- D. Seismic Restraint: Fabricate in compliance with SMACNA (SRM) requirements; see Section 230548.
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
 - 1. Low Pressure Service: Up to 2 in-wc:
 - a. Seal: Class C, apply to seal off transverse joints.
 - b. Leakage:
 - 1) Rectangular: Class 24 or 24 cfm/100 sq ft.
 - 2) Round: Class 12 or 12 cfm/100 sq ft.
 - 2. Low Pressure Service: From 2 in-wc to 3 in-wc:
 - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.

- b. Leakage:
 - 1) Rectangular: Class 12 or 12 cfm/100 sq ft.
 - 2) Round: Class 6 or 6 cfm/100 sq ft.

F. Duct Fabrication Requirements:

- 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
- 2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
- 3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
- 4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- 5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- 6. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.2 METAL DUCTS

A. Material Requirements:

- 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

B. Round Spiral Duct:

- 1. Round spiral lock seam duct with galvanized steel outer wall.

C. Connectors, Fittings, Sealants, and Miscellaneous:

- 1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
- 2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
- 3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - c. For Use with Flexible Ducts: UL labeled.
- 4. Gasket Tape:

- a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
 - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
 - b. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
 - c. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
 - d. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
 - e. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

2.3 FLEXIBLE DUCTS

- A. Flexible Air Ducts:
 1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
 2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 3. Pressure Rating: From at least 2 in-wc positive to 0.5 in-wc negative.
 4. Maximum Velocity: 4,000 fpm.
 5. Maximum length: 5 feet
 6. Insulation: Minimum R-4.2, unless otherwise indicated.
 7. Temperature Range: 0 to 200 degrees F.
 8. Manufacturers:
 - a. Casco, Silent Flex II.
 - b. Flexmaster, Type 1M or Type 6M.
 - c. Atco, UPC#037

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Flexible Ducts: Connect to metal ducts with mechanical fastener.

- F. Exposed, Painted Ductwork: Prior to painting prepare ductwork surface by cleaning with water-based detergent to remove residual dirt and lubricating oils and wipe dry with lint free cloth.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.
- H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use double nuts and lock washers on threaded rod supports for equipment subject to vibration.
- K. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- L. Louver Fit-out:
 - 1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.
 - 2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.
- M. Fire Partitions: Provide firestopping sealing. See Section 078400.
- N. Duct Accessories, Terminal Units, Inlets, and Outlets: Interconnect as indicated in Sections 233300, 233600, and 233700.
- O. Duct Insulation: Provide duct insulation. See Section 230713.
- P. Painting: Provide surface finish as indicated on drawings. See Sections 099113 and 099123.
- Q. Ductwork Penetrations Below HVAC Units: Cut away roofing only where necessary to accommodate supply and return ducts. Seal all gaps around supply and return ducts with acoustic mastic.

3.2 DUCT LEAKAGE TESTING

- A. Duct leakage testing shall follow requirements in California Mechanical Code, Chapter 6 and shall follow procedures in HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

3.3 CLEANING

- A. Clean thoroughly each duct system. See Section 234100.

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END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Combination fire and smoke dampers.
- D. Duct access doors.
- E. Manual volume control dampers.
- F. Remote Actuated Volume Control Dampers
- G. Miscellaneous Products:
 - 1. Damper operators.
 - 2. Damper position switch.
 - 3. Duct opening closure film.
- H. Remote actuated volume control dampers.

1.2 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- B. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- D. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- E. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. Product Data: Provide for shop-fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Comply with NFPA 90A and NFPA 90B.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.2 BACKDRAFT DAMPERS - METAL

- A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 - 1. Greenheck: <https://www.greenheck.com/#sle>
 - 2. Nailor Industries Inc
 - 3. Pottorff; Model FSD-140 (Basis of Design): www.pottorff.com/#sle.
 - 4. Ruskin Company: www.ruskin.com/#sle
 - 5. United Enertech: www.unitedenertech.com/#sle.
- B. Ratings:
 - 1. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.
 - 2. Fire Rating: 1-1/2 hours or 3-hours in accordance with UL-555.
 - 3. Smoke Rating: Class-2 (20 cfm/sf at 4 in wg) leakage in accordance with UL-555S
 - 4. Air Flow Rating: 2000 fpm
 - 5. Differential Pressure Rating: 4 in.wg.
- C. Provide factory sleeve and collar for each damper.
- D. Construction:

1. Frame: Hat-shaped channel, roll formed galvanized steel with interlocking gusseted corners. Structurally equivalent to 13 gauge (2.3mm) U-channel type frame. Low profile head and sill on sizes less than 13 inches (330 mm) high.
 2. Blades: 6 inch maximum width x 16 gauge (152mm x 1.6mm), 3-V shape, roll formed galvanized steel.
 3. Blade Seals: Silicone rubber permanently bonded to blade.
 4. Jamb Seals: Stainless steel, flexible metal compression type.
 5. Axels: Minimum ½" (13mm) diameter plated steel hex-shaped, mechanically attached to blade.
 6. Bearings: Self-lubricating stainless steel, sleeve-type turning in extruded hole in frame.
 7. Linkage: Concealed in frame.
 8. Fire Closure Device: Resettable
 9. Release Temperature: 165 F
 10. Mounting: Vertical and/or Horizontal (1 ½ hour rated only)
 11. Sleeve: Standard 16 inches long x 20 gauge (406mm x 1.0mm), factory installed.
 12. Actuator: Electric 120 V, 60 Hz, two-position, fail close, external mount
- E. Position Indicator Switch Package: Shall connect directly to the blade axel for positive annunciation (interconnecting arms, wire-forms, or brackets shall not be accepted) and provide full open and full closed blade indication to a remote location.
- F. Damper shall be controlled by area wide smoke and fire detection and alarm system. Coordinate with Section 283000 "Fire Alarm System"

2.4 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Access doors with sheet metal screw fasteners are not acceptable.

2.5 MANUAL VOLUME CONTROL DAMPERS

- A. Manufacturers:
 1. Nailor Industries, Inc: www.nailor.com/#sle.
 2. Ruskin Company: www.ruskin.com/#sle.
 3. United Enertech: www.unitedenertech.com/#sle.
- B. Application: Provide Manual Volume Control Dampers for any balancing damper located in an accessible location.
- C. Fabricate in accordance with SMACNA (DCS) and as indicated.
- D. Single Blade Dampers:
 1. Fabricate for duct sizes up to 6 by 30 inch.
 2. Blade: 24 gauge, 0.0239 inch, minimum.

- E. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches. Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
 - 1. Blade: 18 gauge, 0.0478 inch, minimum.
- F. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
- G. Quadrants:
 - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.6 REMOTE ACTUATED VOLUME CONTROL DAMPERS

- A. Application: Provide battery powered, low-voltage Remote Actuated Volume Control Dampers for any balancing damper located in hard ceiling or inaccessible locations.
- B. Manufacturers:
 - 1. Young's Regulator
 - 2. Metropolitan Air Technology
 - 3. Ruskin
- C. Description: Balancing Damper actuated by a low voltage (9V or 12V) DC motor for use above hard ceilings and in other inaccessible locations. Remote controller provides power, control and damper position feedback via a cable of up to 500 feet.
- D. Fabricate in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- E. Shell: Galvanized steel, 24 gage minimum.
- F. Blade: Galvanized steel, 20 gage minimum.
- G. Shaft: 1/2" Plated Steel
- H. Bushing: Oil Impregnated Bronze
- I. Controller: Hand held, battery powered controller, with position indicator.
- J. Termination: Concealed and located as indicated on Drawings. If termination is not indicated on Drawings, locate termination in concealed, accessible ceiling areas, or if not feasible, locate termination recessed in hard ceiling with escutcheon plate to match ceiling color

2.7 MISCELLANEOUS PRODUCTS

- A. Damper Operators: Provide electric operators; see Section 253513.
- B. Damper position switch; see Section 253516.
- C. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
 - 1. Thickness: 2 mils.
 - 2. High tack water based adhesive.
 - 3. UV stable light blue color.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 233100 for duct construction and pressure class.
- B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch size access door for balancing dampers only. Review locations prior to fabrication.
- C. Provide duct test holes where indicated and required for testing and balancing purposes.
- D. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- E. Demonstrate re-setting of fire dampers to Owner's representative.
- F. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
- H. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

- I. Use splitter dampers only where indicated.
- J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION 233300

SECTION 233319 - DUCT SILENCERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct silencers.
- B. Ductwork lagging.

1.2 RELATED REQUIREMENTS

- A. Section 233100 - HVAC Ducts and Casings: Connections to silencers.
- B. Section 233300 - Air Duct Accessories: Flexible duct connections.

1.3 REFERENCE STANDARDS

- A. ANSI/ASA S1.4 PART 3 - American National Standard Electroacoustics – Sound Level Meters – Part 3: Periodic Tests; 2014 (Reaffirmed 2019).
- B. NEBB (STDS) - Procedural Standard for Measurement of Sound and Vibration; 2015, with Errata (2022).
- C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

- A. Product Data: Provide catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance.
- B. Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.
- C. Manufacturer's Installation Instructions: Indicate installation procedures necessary to maintain integrity of sound isolation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Industrial Acoustics Company (IAC).
- B. Price Industries.

2.2 DUCT SILENCERS

- A. Description: Duct section with sheet metal outer casing, sound absorbing fill material, and inner casing of perforated sheet metal; incorporating interior baffles of similar construction. Fabricate in accordance with SMACNA (DCS) HVAC Duct Construction Standards.
- B. Materials:
 - 1. Outer Casing: Minimum 22 gauge, 0.0299 inch thick galvanized steel stiffened as required, with mastic filled lock formed seams, 2 inch long, 11 gauge, 0.1196 inch slip joints on both ends.
 - 2. Inner Casing and Splitters: Minimum 22 gauge, 0.0299 thick perforated galvanized steel.
 - 3. Fill: Natural fiber or mineral wool of minimum 4 lb/cu ft density.
 - 4. Fill Liner: Bonded glass fiber matting.
- C. Configuration: Refer to Drawings.
- D. Performance: Refer to Drawings.

2.3 DUCTWORK LAGGING

- A. Acoustic Insulation: 2 inch thick, 3 to 5 lb/cu ft density glass fiber or mineral wool insulation.
- B. Covering: Sheet lead with surface weight minimum 4 lb/sq ft.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Support duct silencers independent of ducts with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet. Refer to Section 233100 and Section 233300.
- C. Where indicated, lag ductwork by wrapping with insulation and covering. Apply covering to be air tight. Do not attach covering rigidly to ductwork.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of an independent testing agency to take noise measurements in accordance with provisions of NEBB (STDS). Use meters meeting requirements of ANSI/ASA S1.4 PART 3.
- C. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations, as directed.

- D. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements.
- E. Submit complete report of test results including sound curves.

END OF SECTION 233319

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Upblast roof exhausters.

1.2 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- G. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set for each individual fan.

1.4 FIELD CONDITIONS

- A. Request Owner permission to use permanent ventilator(s) for ventilation during construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Greenheck Fan Corporation: www.greenheck.com/#sle.
- B. Loren Cook Company: www.lorencook.com/#sle.
- C. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.
- D. Substitutions: Refer to Division 01.

2.2 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.3 UPBLAST ROOF EXHAUSTERS

- A. Direct Drive Fan:
 - 1. Fan Wheel:
 - a. Type: Non-overloading, backward inclined centrifugal.
 - b. Material: Aluminum, statically and dynamically balanced.
 - 2. Housing:
 - a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
 - b. Rigid internal support structure.
 - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
 - d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.
- B. Shafts and Bearings:
 - 1. Fan Shaft:
 - a. Ground and polished steel with anti-corrosive coating.

- b. First critical speed at least 25 percent over maximum cataloged operating speed.
- 2. Bearings:
 - a. Permanently sealed or pillow block type.
 - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 - c. 100 percent factory tested.
- C. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 - 2. Belts: Static free and oil resistant.
 - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 4. Motor pulley adjustable for final system balancing.
 - 5. Readily accessible for maintenance.
- D. Drain Trough: Allows for single-point drainage of water, grease, and other residues.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Provide sheaves required for final air balance.
- E. Install backdraft dampers on inlet to roof and wall exhausters.

3.2 SCHEDULES

- A. Refer to Drawings.

END OF SECTION 233423

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SECTION 233600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single-duct terminal units.
- B. Controls for terminal units.

1.2 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017.
- C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- D. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).
- E. ASTM A603 - Standard Specification for Zinc-Coated Steel Structural Wire Rope; 1998 (Reapproved 2014).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.

- D. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.
- E. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements for additional provisions.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 SINGLE-DUCT, VARIABLE-VOLUME AND CONSTANT-VOLUME UNITS

- A. Manufacturers:
 - 1. Price Industries, Inc[<>]: www.priceindustries.com/#sle.
 - 2. Krueger-HVAC:[Model LMHS]: www.krueger-hvac.com/#sle.
 - 3. Titus HVAC: www.titus-hvac.com/#sle.
- B. Basis of Design: Price Industries, Inc: www.priceindustries.com/#sle.
 - 1. Single-Duct Terminal Unit: SDV, (direct digital controls).
- C. Acoustic Performance Requirements:
 - 1. Sound ratings of air distribution assemblies: Not to exceed 25 NC at a 0.75 in wg static pressure drop across the unit, and the downstream static pressure of 0.50 in wg.
- D. General:
 - 1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
 - 2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

E. Unit Casing:

1. Minimum 22 gauge, 0.0299 inch galvanized steel.
2. Air Inlet Collar: Provide round, suitable for standard duct sizes.
3. Unit Discharge: Rectangular, with slip-and-drive connections.
4. Acceptable Liners:
 - a. 1 inch thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
 - b. Liner shall have a density of 1.5 pound / cubic foot and an R-value of 4.0.
 - c. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

F. Damper Assembly:

1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak damper blades for tight airflow shutoff.
 - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 in-wc inlet static pressure, tested in accordance with ASHRAE Std 130.

G. Electric Heating Coil:

1. Listed and provided by the terminal unit manufacturer.
2. Coil Casing: 20 gauge, 0.0359 inch galvanized steel.
3. Heating Elements: Nickel chrome, supported by ceramic insulators.
4. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
6. Provide the following additional components, mounted and/or wired within the control enclosure:
 - a. Fused or non-fused door interlocking disconnect switch.
 - b. Mercury contactors.
 - c. Fuse block.
7. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.

H. Electrical Requirements:

1. Equipment wiring to comply with requirements of NFPA 70.

2.2 CONTROLS FOR TERMINAL UNITS

A. Direct or Distributed Digital (DDC):

1. Controller:
 - a. Factory mounted application specific controller, see Section 230923.
 - b. Air volume controller: micro-processor based, pressure independent, with electronic airflow transducers, factor-calibrated maximum and minimum airflow rates.
 - c. Accuracy: Plus/minus five percent of analog input readings and analog outputs.
 - d. Proportional plus integral control of room temperature.
 2. Upstream Flow Sensor: Pitot-tube array.
 3. Discharge Temperature Sensor: Duct-mounted probe.
 4. Zone Thermostat:
 - a. Temperature sensor based device.
 - b. Show values and setpoint on numeric display in fahrenheit units.
 - c. Wall-mounted with occupancy sensor, setpoint adjust, and service port.
 5. Damper Actuator:
 - a. Direct-mounted, modulating, fail last actuator.
 6. Heater Section:
 - a. SCR (silicone-controlled rectifier) unless factory-provided.
 7. The following control components shall be factory installed.
 - a. DDC controller
 - b. Controller enclosure
 - c. flow transducer
 - d. damper actuator
 - e. valve actuator
 8. The following devices shall be factory provided and field installed.
 - a. 120V to 24V transformer
- B. Remote Operation:
1. Occupied and unoccupied operating modes.
 2. Remote reset of temperature of airflow setpoints.
 3. Monitoring and adjusting with portable terminal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.

- F. Provide seismic restraints for any terminal air unit with weight in excess of 25 lbs.
- G. Connect to ductwork in accordance with Section 233100.
- H. Provide minimum of either 24" or 3 times inlet duct diameter of straight supply air duct at inlet connection to terminal air unit.
- I. Provide either attenuator section as indicated on drawings or provide minimum of 4 ft of 1 inch thick lined ductwork downstream of terminal air units.
- J. Verify that electric power is available and of the correct characteristics.

3.2 ADJUSTING

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
 - 1. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Test and adjust controls and safeties.
 - c. Replace damaged and malfunctioning controls and other equipment.
 - d. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 233600

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SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers:
 - 1. Rectangular ceiling diffusers.
 - 2. Round wall diffusers.
- B. Registers/grilles:
 - 1. Ceiling-mounted, exhaust and return register/grilles.
 - 2. Wall-mounted, exhaust and return register/grilles.

1.2 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Refer to Drawings for air outlet and inlet requirements.

2.2 MANUFACTURERS

- A. Price Industries[<>]: www.price-hvac.com/#sle.
- B. Krueger-HVAC[<>]: www.krueger-hvac.com/#sle.
- C. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.

2.3 RECTANGULAR CEILING DIFFUSERS

- A. Type: Provide square, plaque diffuser to discharge air in 360 degree, one way, two way, three way, and four way pattern.
- B. Connections: Round.
- C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

- D. Fabrication: Steel with baked enamel finish.
- E. Color: As selected by Architect from manufacturer's standard range.

2.4 ROUND WALL DIFFUSER

- A. Type: Round diffuser, double deflection louvered core
- B. Fabrication: Steel with baked enamel finish.
- C. Color: As selected by Architect from manufacturer's standard range.

2.5 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch minimum frames and 22 gauge, 0.0299 inch minimum blades, steel and aluminum with 20 gauge, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.

2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION 233700

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SECTION 234000 - HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Disposable panel filters.
- B. Extended surface high efficiency media filters.
- C. Filter frames and housings.
- D. Filter gauges.

1.2 REFERENCE STANDARDS

- A. AHRI 851 (SI) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).
- B. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. {\ch\#33}
- C. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- D. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.
- D. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section Division 01 for additional provisions.
 - 2. Extra Filters: One set of each type and size.

1.4 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 FILTER MANUFACTURERS

- A. AAF International/American Air Filter: www.aafintl.com/#sle.
- B. The Camfil Group: www.camfilfarr.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with the rating requirements in AHRI 851 (SI).

2.3 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
 - 1. Frame: Cardboard
 - 2. Nominal Thickness: 1 inch.
- B. Minimum Efficiency Reporting Value (MERV): 8, when tested in accordance with ASHRAE 52.2.
- C. Performance Rating:
 - 1. Initial Resistance at 500 FPM face velocity: 0.15 inch WG.
 - 2. Recommended Final Resistance: 0.50 in-wc.
- D. Casing: Cardboard frame.

2.4 EXTENDED SURFACE HIGH EFFICIENCY MEDIA FILTERS

- A. Media: Pleated, water-resistant glass fiber with aluminum separators; in 16 gauge, 0.0598 inch steel holding frame with corrosion resistant coating.
- B. Minimum Efficiency Reporting Value (MERV): _____, when tested in accordance with ASHRAE Std 52.2.
- C. Performance Rating, per ASHRAE Std 52.2:
 - 1. Initial Resistance at 150 fpm Face Velocity: 0.35 in-wc.
 - 2. Recommended Final Resistance: 1.5 in-wc.

2.5 FILTER FRAMES AND HOUSINGS

- A. General: Fabricate filter frames and supporting structures of 16 gauge, 0.0598 inch galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
- B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size for 24 by 24 inches filter media, minimum 2 inches thick; for extended surface and high efficiency particulate air filters, provide for upstream mounting of panel filters.
- C. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gauge, 0.0598 inch galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary secondary filters with positive sealing gaskets.

2.6 FILTER GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 - 2. H.O. Trerice Co: www.trerice.com/#sle.
 - 3. Weiss Instruments: www.weissinstruments.com/#sle.
- B. Direct Reading Dial: 3-1/2 inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 to 0.5 in-wc, 2 percent of full scale accuracy.
- C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch aluminum tubing, 2-way or 3-way vent valves.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.
- E. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

3.2 SCHEDULES:

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05/23/2025

A. Refer to Drawings.

END OF SECTION 234000

SECTION 237414 - PACKAGED OUTDOOR HEAT PUMP UNITS

PART 1: GENERAL

1.1 SECTION INCLUDES

- A. Packaged Rooftop air conditioners

1.2 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99—Standards Handbook
- C. AMCA 500—Test Methods for Louver, Dampers, and Shutters.
- D. AHRI 340/360 - Unitary Large Equipment
- E. NEMA MG1—Motors and Generators
- F. National Electrical Code.
- G. NFPA 70—National Fire Protection Agency.
- H. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
- I. UL 900—Test Performance of Air Filter Units.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- B. Product Data:
 - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, and electrical characteristics and connection requirements.
 - 2. Provide computer generated fan curves with specified operating point clearly plotted.
 - 3. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Provide instructions for installation, maintenance and service

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.
- B. Startup must be done by trained personnel experienced with rooftop equipment.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site and inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.7 WARRANTY

- A. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

PART 2: PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Daikin Applied
- B. Aeon
- C. Trane
- D. York

2.2 GENERAL DESCRIPTION

- A. Furnish as shown on plans, Daikin Applied Rebel Single zone Heating and Cooling Unit(s) model DPS. Unit performance and electrical characteristics shall be per the job schedule.
- B. Configuration: Fabricate as detailed on prints and drawings:

1. Return plenum / economizer section
 2. Filter section
 3. Cooling coil section
 4. Supply fan section
 5. Condensing unit section
- C. The complete unit shall be cETLus listed.
- D. The unit shall be ASHRAE 90.1-2016 compliant and labeled.
- E. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-32 Refrigerant and oil.
- F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
- G. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- H. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.
- I. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

2.3 CABINET, CASING, AND FRAME

- A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 2" thick with an R-value of 13.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

- B. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16" at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.
- C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.4 OUTDOOR/RETURN AIR SECTION

- A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in accordance with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for "free" cooling. If outdoor air is suitable for "free" cooling, the outdoor air dampers shall modulate in response to the unit's temperature control system.
- B. Provide factory installed and tested, outdoor air monitor that controls outdoor air +/- 15% accuracy down to 40 cfm per ton.

- C. Economizer assembly Fault Detection and Diagnostics (FDD) shall be 90.1, IECC, and California Title 24 compliant. MicroTech III controls shall display a warning, and write a warning to the BAS, if the economizer malfunctions in accordance with 90.1, IECC, and Title 24 specifications.

2.5 EXHAUST FAN

- A. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
- B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
- C. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.

2.6 FILTERS

- A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 and 4" MERV 13 filters.

2.7 COOLING COIL

- A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
- B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
- C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

- D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
- E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

2.8 SUPPLY FAN

- A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
- B. All fan assemblies shall employ solid steel fan shafts. Heavy-duty pillow block type, self-aligning, grease lubricated ball bearings shall be used. Bearings shall be sized to provide a L-50 life at 250,000 hours. The entire fan assembly shall be isolated from the fan bulkhead with a flexible collar and mounted on 1" spring isolators.
- C. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
- D. Supply fan and motor assembly combinations larger than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.
- E. The motor shall be T Frame and open drip proof. Overload protection and speed control is provided by the factory installed VFD and rooftop unit controller. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
- F. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.9 VARIABLE AIR VOLUME CONTROL

- A. An electronic variable frequency drive shall be provided for the supply air fan. Each drive shall be factory installed out of the air stream in a conditioned cabinet. Drives shall meet UL Standard 95-5V. The completed unit assembly shall be listed by a recognized safety agency, such as ETL. Drives are to be accessible through a hinged door assembly. Mounting arrangements that expose drives to high temperature unfiltered ambient air are not acceptable.
- B. The unit manufacturer shall install all power and control wiring.

- C. The supply air fan drive output shall be controlled by the factory installed main unit control system and drive status and operating speed shall be monitored and displayed at the main unit control panel.

2.10 CONDENSING SECTION

- A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
- B. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 0~120°F. Mechanical cooling shall be provided to 0° F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
- C. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.
- D. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and low oil safety protection.
- E. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- F. Each circuit shall be dehydrated and factory charged with R-32 Refrigerant and oil.
- G. ELECTRICAL

- H. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

2.11 CONTROLS

- A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.
- B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
- C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.
- D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.
- E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

1. Return air temperature.
2. Discharge air temperature.
3. Outdoor air temperature.
4. Space air temperature.
5. Outdoor enthalpy, high/low.
6. Compressor suction temperature and pressure
7. Compressor head pressure and temperature
8. Expansion valve position
9. Condenser fan speed
 - a. Inverter compressor speed
 - b. Dirty filter indication.
 - c. Airflow verification.
 - d. Cooling status.
 - e. Control temperature (Changeover).
 - f. VAV box output status.
 - g. Cooling status/capacity.
 - h. Unit status.
 - i. All time schedules.
 - j. Active alarms with time and date.
 - k. Previous alarms with time and date.
 - l. Optimal start
 - m. Supply fan and exhaust fan speed.
 - n. System operating hours.
 - 1) Fan
 - 2) Exhaust fan
 - 3) Cooling
 - 4) Individual compressor
 - 5) Heating
 - 6) Economizer
 - 7) Tenant override

G. The user interaction with the keypad shall provide the following:

1. Controls mode
 - 1) Off manual
 - 2) Auto

- 3) Heat/Cool
- 4) Cool only
- 5) Heat only
- 6) Fan only
2. Occupancy mode
 - 1) Auto
 - 2) Occupied
 - 3) Unoccupied
 - 4) Tenant override
3. Unit operation changeover control
 - 1) Return air temperature
 - 2) Space temperature
 - 3) Network signal
4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
 - 1) Return air temperature
 - 2) Outdoor air temperature
 - 3) Space temperature
 - 4) Airflow (VAV)
 - 5) Network signal
 - 6) External (0-10 vdc)
 - 7) External (0-20 mA)
7. Temperature alarm limits
 - 1) High supply air temperature
 - 2) Low supply air temperature
 - 3) High return air temperature
8. Lockout control for compressors.
9. Compressor interstage timers
 - a. Night setback and setup space temperature.
 - b. Building static pressure.
 - c. Economizer changeover
 - 1) Enthalpy
 - 2) Drybulb temperature
 - d. Currently time and date
 - e. Tenant override time

- f. Occupied/unoccupied time schedule
 - g. One event schedule
 - h. Holiday dates and duration
 - i. Adjustable set points
 - j. Service mode
 - 1) Timers normal (all time delays normal)
 - 2) Timers fast (all time delays 20 sec)
- H. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
 - 1. Zone sensor with tenant override switch
 - 2. Zone sensor with tenant override switch plus heating and cooling set point adjustment.
(Space Comfort Control systems only)
- I. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
 - 1. Airflow
 - 2. Outside air temperature
 - 3. Space temperature
 - 4. Return air temperature
 - 5. External signal of 1-5 vdc
 - 6. External signal of 0-20 mA
 - 7. Network signal

2.12 ROOF CURB

- A. Roof curbs with vibration isolators are specified in section 230548 "Vibration and Seismic Controls for HVAC. Gasket shall be provided for field mounting between the unit base and roof curb.

PART 3 - EXECUTION

3.1 INSTALLATION, OPERATION, AND MAINTENANCE

- A. Installation, Operation and Maintenance manual shall be supplied with the unit.
- B. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

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END OF SECTION 237414

SECTION 238126 - SPLIT-SYSTEM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air cooled condensing units.
- B. Indoor air handling (fan and coil) units for ductless systems.
- C. Refrigerant piping.

1.2 REFERENCE STANDARDS

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2019, with All Amendments and Errata.
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2021.
- G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- D. Design Data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.5 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Daikin: www.daikinac.com/#sle.
- B. Carrier Corporation: www.carrier.com/#sle.
- C. Trane Inc: www.trane.com/#sle.
- D. York International Corporation / Johnson Controls: www.york.com/#sle.
- E. Substitutions: See Section 016000 - Product Requirements.

2.2 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
 - 1. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with all refrigerant lines insulated.
- B. Performance Requirements: See Drawings for additional requirements.
- C. Electrical Characteristics: As Indicated on Drawings
 - 1. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 260583.

2.3 INDOOR AIR HANDLING UNITS FOR DUCTLESS SYSTEMS

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

1. Location: Ceiling or Wall Mount as Indicated.
 2. Cabinet: Galvanized steel.
 3. Fan: Line-flow fan direct driven by a single motor.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
 2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Comply with AHRI 210/240.
 2. Refrigerant: R-410A.
 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high-pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
- C. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
- D. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.
- E. Mounting Pad: Precast concrete parking bumpers, minimum 4 inches square; minimum of two located under cabinet feet.

2.5 REFRIGERANT PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.
1. Fittings: ASME B16.22 wrought copper.
 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Pipe Supports and Anchors:
1. Provide hangers and supports that comply with MSS SP-58.
 - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

C. Refrigerant Piping Insulation

1. Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
 - a. Minimum Service Temperature: -40 degrees F.
 - b. Maximum Service Temperature: 220 degrees F.
 - c. Connection: Waterproof vapor barrier adhesive.
2. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.6 ACCESSORY EQUIPMENT

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.

3.2 PIPING INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Install refrigeration systems in accordance with ASHRAE Std 15.
- G. Provide pressure testing for refrigerant piping per manufacturer's recommendations.
- H. Pipe condensate drain from indoor unit to drain as indicated on Drawings.
- I. Insulate all refrigerant system suction, liquid, hot-gas and discharge piping per insulation schedule, code requirements, and equipment manufacturer recommendations.
 1. Flexible Elastomeric Cellular Insulation, minimum 1 inch thick.
- J. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.

3.3 SCHEDULE

- A. Refer to Drawings.

END OF SECTION 238126

DIVISION 26

ELECTRICAL

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Nonmetallic-sheathed cable.
- C. Underground feeder and branch-circuit cable.
- D. Service entrance cable.
- E. Armored cable.
- F. Metal-clad cable.
- G. Power and control tray cable.
- H. Manufactured wiring systems.
- I. Wiring connectors.
- J. Electrical tape.
- K. Heat shrink tubing.
- L. Oxide inhibiting compound.
- M. Wire pulling lubricant.
- N. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping.
- B. Section 260505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- C. Section 260513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.
- D. Section 260519.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.

- E. Section 260526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- F. Section 260536 - Cable Trays for Electrical Systems: Additional installation requirements for cables installed in cable tray systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.
- I. Section 263100 - Photovoltaic Collectors: Additional wiring requirements for photovoltaic systems.
- J. Section 284600 - Fire Detection and Alarm: Fire alarm system conductors and cables.
- K. Section 312316 - Excavation.
- L. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
- M. Section 312323 - Fill: Bedding and backfilling.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM B800 - Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes - Annealed and Intermediate Tempers; 2005 (Reapproved 2011).
- F. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- G. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

- H. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification; Revision A, 2008.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- J. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.
- K. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2007.
- L. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- M. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. UL 4 - Armored Cable; Current Edition, Including All Revisions.
- P. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- Q. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- R. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- S. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- T. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- U. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
- V. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- W. UL 719 - Nonmetallic-Sheathed Cables; Current Edition, Including All Revisions.
- X. UL 854 - Service-Entrance Cables; Current Edition, Including All Revisions.
- Y. UL 1277 - Electrical Power and Control Tray Cables with Optional Optical-Fiber Members; Current Edition, Including All Revisions.
- Z. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Sustainable Design Documentation: Submit manufacturer's product data on conductor and cable showing compliance with specified lead content requirements.
- D. Manufactured Wiring System Shop Drawings: Provide plan views indicating proposed system layout with components identified; indicate branch circuit connections.
- E. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors. Include proposed modifications to raceways, boxes, wiring gutters, enclosures, etc. to accommodate substituted conductors.
- F. Field Quality Control Test Reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Manufactured Wiring Systems Cable Assemblies: One of each configuration, 6 feet length.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
 - 1. Exceptions:
 - a. Use manufactured wiring systems for branch circuits where concealed under raised floors.
 - 1) Exception: Provide single conductor building wire in raceway for circuit homerun from distribution box to panelboard.
 - b. Use power and control tray cable or metal-clad cable for installation in cable tray.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Armored cable is permitted only as follows:

1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet.
 2. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations.
 - f. For isolated ground circuits.
- F. Metal-clad cable is permitted only as follows:
1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - 1) Maximum Length: 6 feet.
 2. In addition to other applicable restrictions, may not be used:
 - a. Unless approved by Owner.
 - b. Where not approved for use by the authority having jurisdiction.
 - c. Where exposed to view.
 - d. Where exposed to damage.
 - e. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:

1. Provide copper conductors except where aluminum conductors are specifically indicated. Substitution of aluminum conductors for copper is not permitted. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
 4. Aluminum Conductors (only where specifically indicated or permitted for substitution): AA-8000 series aluminum alloy conductors recognized by ASTM B800 and compact stranded in accordance with ASTM B801 unless otherwise indicated.
- H. Minimum Conductor Size: 12 AWG.
1. Branch Circuits: 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.
 2. Control Circuits: 14 AWG.
- I. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- J. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.

- c. Equipment Ground, All Systems: Green.
- d. Isolated Ground, All Systems: Green with yellow stripe.
- e. Travelers for 3-Way and 4-Way Switching: Pink.
- f. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

2.3 SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers:

1. Copper Building Wire:

- a. Cerro Wire LLC: www.cerrowire.com.
- b. Encore Wire Corporation: www.encorewire.com/#sle.
- c. General Cable Technologies Corporation: www.generalcable.com/#sle.
- d. Southwire Company: www.southwire.com/#sle.
- e. Substitutions: See Section 016000 - Product Requirements.

2. Aluminum Building Wire (only where specifically indicated or permitted for substitution):

- a. Encore Wire Corporation: www.encorewire.com/#sle.
- b. Southwire Company: www.southwire.com/#sle.
- c. Stabiloy, a brand of General Cable Technologies Corporation:
www.stabiloy.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

- 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- 2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

- 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
 - c. Fixture Wiring Within Luminaires: Type TFFN/TFN for luminaires with labeled maximum temperature of 90 degrees C; Approved suitable type for luminaires with labeled maximum temperature greater than 90 degrees C.
- 2. Aluminum Building Wire (only where specifically indicated or permitted for substitution): Type XHHW-2.

2.4 NONMETALLIC-SHEATHED CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC: www.cerrowire.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type NM multiple-conductor cable listed and labeled as complying with UL 719, Type NM-B.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.

2.5 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC: www.cerrowire.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.
- F. Cable Jacket: Listed and labeled as sunlight resistant.

2.6 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 - 1. Copper Service Entrance Cable:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. Southwire Company: www.southwire.com/#sle.

- d. Substitutions: See Section 016000 - Product Requirements.
- 2. Aluminum Service Entrance Cable:
 - a. Encore Wire Corporation: www.encorewire.com/#sle.
 - b. General Cable Technologies Corporation
 - c. Sttabiloy
 - d. Southwire Company: www.southwire.com/#sle.
- B. Service Entrance Cable for Underground Use: NFPA 70, Type USE single-conductor cable listed and labeled as complying with UL 854, Type USE-2, and with UL 44 Type RHH/RHW-2.
- C. Conductor Stranding: Stranded.
- D. Insulation Voltage Rating: 600 V.

2.7 ARMORED CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Southwire Company: www.southwire.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type AC cable listed and labeled as complying with UL 4, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN.
- F. Grounding: Combination of interlocking armor and integral bonding wire.
 - 1. Provide additional full-size integral insulated equipment grounding conductor for redundant grounding, suitable for general purpose, non-essential electrical systems in non-hazardous patient care areas of health care facilities.
- G. Armor: Steel, interlocked tape.

2.8 POWER AND CONTROL TRAY CABLE

- A. Manufacturers:
 - 1. Encore Wire Corporation: www.encorewire.com/#sle.
 - 2. General Cable Technologies Corporation

3. Okonite: www.okonite.com/#sle.
 4. Southwire Company: www.southwire.com/#sle.
 5. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type TC cable listed and labeled as complying with UL 1277.
- C. Where exposed run cable is indicated between cable tray and utilization equipment in qualifying industrial establishments as determined by authorities having jurisdiction, provide tray cable marked as Type TC-ER in accordance with NFPA 70.
- D. Conductor Stranding: Stranded.
- E. Insulation Voltage Rating: 600 V.
- F. Insulation: Type XHHW or XHHW-2.
- G. Grounding: Full-size integral equipment grounding conductor.
- H. Jacket: PVC or Chlorinated Polyethylene (CPE).

2.9 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 260526.
- C. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
 6. Aluminum Conductors: Use compression connectors for all connections.

7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
8. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. NSI Industries LLC: www.nsiindustries.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- H. Push-in Wire Connectors: Rated 600 V, 221 degrees F.
 1. Manufacturers:
 - a. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - b. NSI Industries LLC: www.nsiindustries.com/#sle.
 - c. Wago Corporation: www.wago.us/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- I. Mechanical Connectors: Provide bolted type or set-screw type.
 1. Manufacturers:
 2.
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Bundy, LLC
 - c. Ilsco: www.ilsco.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- J. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- K. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.

- b. IlSCO: www.ilsco.com/#sle.
- c. Thomas & Betts Corporation: www.tnb.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

2.10 WIRING ACCESSORIES

A. Electrical Tape:

- 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
- 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
- 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- 4. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
- 5. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
- 6. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
- 7. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

- 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

- 1. Manufacturers:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. IlSCO: www.ilsco.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.

D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

1. Manufacturers:

- a. 3M: www.3m.com/#sle.
- b. American Polywater Corporation: www.polywater.com/#sle.
- c. Ideal Industries, Inc: www.idealindustries.com/#sle.
- d. Substitutions: See Section 016000 - Product Requirements.

E. Cable Ties: Material and tensile strength rating suitable for application.

1. Manufacturers:

- a. Burndy LLC: www.burndy.com/#sle.
- b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Arrange circuiting to minimize splices.
4. Include circuit lengths required to install connected devices within 10 ft of location indicated.
5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
9. Provide oversized neutral/grounded conductors where indicated and as specified below.
 - a. Provide 200 percent rated neutral for feeders fed from K-rated transformers.
 - b. Provide 200 percent rated neutral for feeders serving panelboards with 200 percent rated neutral bus.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install armored cable (Type AC) in accordance with NECA 120.
- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- I. Terminate cables using suitable fittings.
 1. Armored Cable (Type AC):
 - a. Use listed fittings and anti-short, insulating bushings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.
 2. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
 - c. Do not use direct-bearing set-screw type fittings for cables with aluminum armor.

- J. Install conductors with a minimum of 12 inches of slack at each outlet.
- K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- N. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- P. Insulate ends of spare conductors using vinyl insulating electrical tape.
- Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.
- F. Chemically-enhanced ground electrodes.
- G. Ground plate electrodes.
- H. Ground enhancement material.
- I. Ground access wells.
- J. Pre-fabricated signal reference grids.

1.2 RELATED REQUIREMENTS

- A. Section 096500 - Resilient Flooring: Static control flooring.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
 - 1. Includes oxide inhibiting compound.
- C. Section 260536 - Cable Trays for Electrical Systems: Additional grounding and bonding requirements for cable tray systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 263100 - Photovoltaic Collectors: Additional grounding and bonding requirements for photovoltaic systems.
- F. Section 265600 - Exterior Lighting: Additional grounding and bonding requirements for pole-mounted luminaires.
- G. Section 337900 - Site Grounding.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 99 - Health Care Facilities Code; 2015.
- G. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2014.
- H. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 3. For signal reference grids, coordinate the work with access flooring furnished in accordance with Section 096900.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field quality control test reports.
- F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
3. Metal In-Ground Support Structure:
 - a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground enhancement material around electrode where indicated.
 - e. Provide ground access well for each electrode.

6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
 7. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
 - a. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - b. Where ground bar location is not indicated, locate in accessible location as near as possible to service disconnect enclosure.
 - c. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.
 8. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.
- G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.
 3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- I. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 - b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
 - c. Generators, when neutral is switched in the transfer switch.
 2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
5. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
6. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
7. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.

10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

K. Isolated Ground System:

1. Where isolated ground receptacles or other isolated ground connections are indicated, provide separate isolated/insulated equipment grounding conductors.
2. Connect isolated/insulated equipment grounding conductors only to separate isolated/insulated equipment ground busses.
3. Connect the isolated/insulated equipment grounding conductors to the solidly bonded equipment ground bus only at the service disconnect or separately derived system disconnect. Do not make any other connections between isolated ground system and normal equipment ground system on the load side of this connection.

L. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
 - a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
 - b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.
 - c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.
 - d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 260526:

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gage of specified conductors.

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.
4. Manufacturers - Mechanical and Compression Connectors:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Burndy LLC: www.burndy.com/#sle.
 - c. Harger Lightning & Grounding: www.harger.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC: www.burndy.com/#sle.
 - b. Cadweld, a brand of Erico International Corporation: www.erico.com/#sle.
 - c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC: www.thermoweld.com/#sle.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.
2. Size: As indicated.
3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.
2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
4. Where rod lengths of greater than 10 feet are indicated or otherwise required, sectionalized ground rods may be used.
5. Manufacturers:
 - a. Advanced Lightning Technology (ALT): www.altfab.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. Galvan Industries, Inc: www.galvanelectrical.com/#sle.
 - d. Harger Lightning & Grounding: www.harger.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.

F. Ground Enhancement Material:

1. Description: Factory-mixed conductive material designed for permanent and maintenance-free improvement of grounding effectiveness by lowering resistivity.
- G. Ground Access Wells:
1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
 2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
 4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.
 2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.
- D. Ground Plate Electrodes: Unless otherwise indicated, install ground plate electrodes at a depth of not less than 30 inches.
- E. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

F. Identify grounding and bonding system components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 260533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- D. Section 260536 - Cable Trays for Electrical Systems: Additional support and attachment requirements for cable tray.
- E. Section 260533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- F. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- G. Section 262513 - Low-Voltage Busways: Additional support and attachment requirements for busway.
- H. Section 263100 - Photovoltaic Collectors: Photovoltaic module mounting systems.
- I. Section 265100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- J. Section 265133 - Luminaires and Drivers - Lutron: Additional support and attachment requirements for luminaires.
- K. Section 265600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023a.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; 2015.
- J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
 - 1. Fiberglass Channel (Strut) Framing Systems: Include requirements for strength derating according to ambient temperature.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Derating Calculations for Fiberglass Channel (Strut) Framing Systems: Indicate load ratings adjusted for applicable service conditions.
- E. Evaluation Reports: For products specified as requiring evaluation and recognition by ICC Evaluation Service, LLC (ICC-ES), provide current ICC-ES evaluation reports upon request.
- F. Installer's Qualification Statement: Include evidence of compliance with specified requirements.
- G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Installer Qualifications for Field-Welding: As specified in Section 055000.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Components for Vibration Isolation and/or Seismic Controls: Comply with Section 260548.
- C. Materials for Metal Fabricated Supports: Comply with Section 055000.
- D. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
 3. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation:
www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- E. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
1. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation:
www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.

- d. Thomas & Betts Corporation: www.tnb.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- F. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
- 1. Comply with MFMA-4.
 - 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 - 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
 - 5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
 - 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Thomas & Betts Corporation: www.tnb.com/#sle.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - e. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- G. Fiberglass Channel (Strut) Framing Systems: Factory-fabricated continuous-slot fiberglass channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
- 1. Channel Material: Use polyester resin or vinyl ester resin.
 - 2. Minimum Channel Dimensions: 1-5/8 inch width by 1 inch height.
 - 3. Flammability: Fire retardant with NFPA 101, Class A flame spread index (maximum of 25) when tested in accordance with ASTM E84; self-extinguishing in accordance with ASTM D635.
 - 4. Manufacturers:
 - a. Enduro Composites: www.endurocomposites.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - c. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
- H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
- 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Busway Supports: 1/2 inch diameter.
 - c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
 - d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - f. Outlet Boxes: 1/4 inch diameter.

- g. Luminaires: 1/4 inch diameter.
- I. Non-Penetrating Rooftop Supports for Low-Slope Roofs: Steel pedestals with thermoplastic or rubber bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 - 1. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 2. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 3. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.
 - 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Erico International Corporation: www.erico.com/#sle.
 - c. PHP Systems/Design: www.phpsd.com/#sle.
 - d. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- J. Anchors and Fasteners:
 - 1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 - 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 - 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
 - 4. Hollow Masonry: Use toggle bolts.
 - 5. Hollow Stud Walls: Use toggle bolts.
 - 6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood: Use wood screws.
 - 9. Plastic and lead anchors are not permitted.
 - 10. Powder-actuated fasteners are not permitted.
 - 11. Hammer-driven anchors and fasteners are not permitted.
 - 12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
 - 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
 - 14. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 - c. Powers Fasteners, Inc: www.powers.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- H. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.
- I. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Conduit Support and Attachment: Also comply with Section 260533.13.

- K. Cable Tray Support and Attachment: Also comply with Section 260536.
- L. Box Support and Attachment: Also comply with Section 260533.16.
- M. Busway Support and Attachment: Also comply with Section 262513.
- N. Interior Luminaire Support and Attachment: Also comply with Section 265100.
- O. Exterior Luminaire Support and Attachment: Also comply with Section 265600.
- P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- Q. Secure fasteners according to manufacturer's recommended torque settings.
- R. Remove temporary supports.
- S. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 260529

SECTION 260533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Aluminum rigid metal conduit (RMC).
- C. Intermediate metal conduit (IMC).
- D. PVC-coated galvanized steel rigid metal conduit (RMC).
- E. Flexible metal conduit (FMC).
- F. Liquidtight flexible metal conduit (LFMC).
- G. Electrical metallic tubing (EMT).
- H. Rigid polyvinyl chloride (PVC) conduit.
- I. Electrical nonmetallic tubing (ENT).
- J. Liquidtight flexible nonmetallic conduit (LFNC).
- K. Reinforced thermosetting resin conduit (RTRC).
- L. Conduit fittings.
- M. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 078400 - Firestopping.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- D. Section 260526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- E. Section 260529 - Hangers and Supports for Electrical Systems.
- F. Section 260533.16 - Boxes for Electrical Systems.

- G. Section 260533.23 - Surface Raceways for Electrical Systems.
- H. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- I. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- J. Section 262100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.
- K. Section 271000 - Structured Cabling: Additional requirements for communications systems conduits.
- L. Section 312316 - Excavation.
- M. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
- N. Section 312323 - Fill: Bedding and backfilling.
- O. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.
- G. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- H. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- I. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.

- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- L. NEMA TC 13 - Electrical Nonmetallic Tubing (ENT); 2014.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- P. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- Q. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- R. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- S. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- T. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- C. Shop Drawings:
 - 1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.
 - 2. Include proposed locations of roof penetrations and proposed methods for sealing.
- D. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Under Slab on Grade: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).

2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, intermediate metallic conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 6. Where steel conduit is installed in direct contact with earth where soil has a resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape to provide supplementary corrosion protection or use PVC-coated galvanized steel rigid metal conduit.
 7. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Embedded Within Concrete:
1. Within Slab on Grade (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 2. Within Slab Above Ground (within structural slabs only where approved by Structural Engineer): Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT). Do not use MC cable in walls or ceilings except for the final connection to lighting fixtures, and less than 6' lengths.
- F. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- H. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).

- I. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- J. Exposed, Exterior: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit.
- K. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).

2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Electrical Service Conduits: Also comply with Section 262100.
- C. Communications Systems Conduits: Also comply with Section 271000.
- D. Fittings for Grounding and Bonding: Also comply with Section 260526.
- E. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- F. Provide products listed, classified, and labeled as suitable for the purpose intended.
- G. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 - 2. Underground, Interior: 3/4 inch (21 mm) trade size.
 - 3. Underground, Exterior: 1 inch (27 mm) trade size.
- H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com/#sle.
 - 2. Republic Conduit: www.republic-conduit.com/#sle.
 - 3. Wheatland Tube, a Division of Zekelman Industries www.wheatland.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 ALUMINUM RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com/#sle.
2. Republic Conduit: www.republic-conduit.com/#sle.
3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.

C. Fittings:

1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material: Use aluminum.
5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit www.alliedeg.com/#sle.

2. Republic Conduit: www.republic-conduit.com/#sle.
 3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.6 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
1. Thomas & Betts Corporation www.tnb.com/#sle.
 2. Robroy Industries www.robroy.com/#sle.
 3. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- D. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Fittings:
1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.
 4. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
- F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.7 FLEXIBLE METAL CONDUIT (FMC)

- A. Manufacturers:

1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.

2.8 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
1. AFC Cable Systems, Inc: www.afcweb.com/#sle.
 2. Electri-Flex Company: www.electriflex.com/#sle.
 3. International Metal Hose: www.metalhose.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
1. Manufacturers:
 - a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.

2.9 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
1. Allied Tube & Conduit www.alliedeg.com/#sle.
 2. Republic Conduit www.republic-conduit.com/#sle.
 3. Wheatland Tube, a Division of Zekelman Industries: www.wheatland.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.

- B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc www.bptfittings.com/#sle.
 - b. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 4. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 - b. Do not use set-screw type connectors and couplings.
 - 5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.
 - 6. Embedded Within Concrete (where permitted): Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.10 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc: www.cantexinc.com/#sle.
 - 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com/#sle.
 - 3. JM Eagle www.jmeagle.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.11 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: Per manufacturer's recommendations.

- C. Fittings: Same type and manufacturer as conduit to be connected.

2.12 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- E. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- F. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- G. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.
- H. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for the conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - I. Bore Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for installation within casing; furnished with roller wheels to facilitate installation, openings to facilitate grout flow, and holes for stabilization cable; suitable for the casing and conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Bore Spacers: www.apsonline.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install aluminum rigid metal conduit (RMC) in accordance with NECA 102.
- E. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- F. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- G. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- H. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
 - 6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 7. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 - 9. Arrange conduit to provide no more than 150 feet between pull points.
 - 10. Route conduits above water and drain piping where possible.
 - 11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.

13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 14. Group parallel conduits in the same area together on a common rack.
- I. Conduit Support:
1. Secure and support conduits in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.
 3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 9. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
 10. Use of spring steel conduit clips for support of conduits is not permitted.
 11. Use of wire for support of conduits is not permitted.
 - a. For securing conduits to studs in hollow stud walls.
 - b. For suspending conduits supported by spring steel conduit clips (only where specifically indicated or permitted).
 12. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- J. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

K. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
9. Provide metal escutcheon plates for conduit penetrations exposed to public view.
10. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.

L. Underground Installation:

1. Provide trenching and backfilling in accordance with Section 312316.13.
2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches.
 - b. Under Slab on Grade: 12 inches to bottom of slab.
3. Provide underground warning tape in accordance with Section 260553 along entire conduit length for service entrance where not concrete-encased.

M. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):

1. Include proposed conduit arrangement with submittals.
2. Maximum Conduit Size: 1 inch (27 mm) unless otherwise approved.
3. Install conduits within middle one third of slab thickness.
4. Secure conduits to prevent floating or movement during pouring of concrete.

- N. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide concrete in accordance with Section 033000 with minimum concrete cover of 3 inches on all sides unless otherwise indicated.
- O. Hazardous (Classified) Locations: Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- P. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 - 4. Where conduits are subject to earth movement by settlement or frost.
- Q. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 - 1. Where conduits pass from outdoors into conditioned interior spaces.
 - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
 - 3. Where conduits penetrate coolers or freezers.
- R. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- S. Provide grounding and bonding in accordance with Section 260526.
- T. Identify conduits in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Boxes for hazardous (classified) locations.
- E. Floor boxes.
- F. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete.
- B. Section 078400 - Firestopping.
- C. Section 083100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- D. Section 260526 - Grounding and Bonding for Electrical Systems.
- E. Section 260529 - Hangers and Supports for Electrical Systems.
- F. Section 260533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- G. Section 260533.23 - Surface Raceways for Electrical Systems:
 - 1. Accessory boxes designed specifically for surface raceway systems.
 - 2. Lay-in wireways and wiring troughs with removable covers.
- H. Section 260539 - Underfloor Raceways for Electrical Systems: Junction boxes for underfloor duct systems.
- I. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- J. Section 260553 - Identification for Electrical Systems: Identification products and requirements.

- K. Section 262726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Poke-through assemblies.
 - 4. Access floor boxes.
 - 5. Additional requirements for locating boxes for wiring devices.
- L. Section 262813 - Fuses: Spare fuse cabinets.
- M. Section 271000 - Structured Cabling: Additional requirements for communications systems outlet boxes.
- N. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes: Concrete manholes for electrical systems.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- L. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Samples:
1. Floor Boxes: Provide one sample(s) of each floor box proposed for substitution upon request.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
 2. Keys for Lockable Enclosures: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
 - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 - 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 - 4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
 - 5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 - 6. Use suitable concrete type boxes where flush-mounted in concrete.
 - 7. Use suitable masonry type boxes where flush-mounted in masonry walls.
 - 8. Use raised covers suitable for the type of wall construction and device configuration where required.
 - 9. Use shallow boxes where required by the type of wall construction.
 - 10. Do not use "through-wall" boxes designed for access from both sides of wall.

11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
 14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
 16. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: Comply with Section 271000.
 17. Wall Plates: Comply with Section 262726.
 18. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Eaton Corporation:
www.cooperindustries.com/#sle.
 - b. Hubbell Incorporated; Bell Products: www.hubbell-rtb.com/#sle.
 - c. Hubbell Incorporated; RACO Products: www.hubbell-rtb.com/#sle.
 - d. O-Z/Gedney, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - e. Thomas & Betts Corporation: www.tnb.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
 - a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
 6. Manufacturers:

- a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products: www.hubbell-wiegmann.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- D. Boxes and Enclosures for Integrated Power, Data, and Audio/Video: Size and configuration as indicated or as required with partitions to separate services; field-connected gangable boxes may be used.
1. Manufacturers:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers:
 - a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.
 - b. Cooper Crouse-Hinds, a division of Eaton Corporation:
www.cooperindustries.com/#sle.
 - c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- F. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 262726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Use cast iron floor boxes within slab on grade.
 3. Use sheet-steel or cast iron floor boxes within slab above grade.
 4. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
 5. Manufacturer: Same as manufacturer of floor box service fittings.
- G. Underground Boxes/Enclosures:
1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As indicated on drawings.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 4. Provide logo on cover to indicate type of service.
 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 15 load rating.

- c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
- 6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com/#sle.
 - 2) MacLean Highline: www.macleanhighline.com/#sle.
 - 3) Oldcastle Precast, Inc: www.oldcastleprecast.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
 - c. Product(s):
 - 1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.
 - (a) 11 by 18 by 12 inches nominal; Model PHA111812 (stackable).
 - 2) MacLean Highline CHA Series: Fiberglass/polymer concrete splice box/pull box; available Tier 8 and Tier 15 load ratings.
 - (a) 11 by 18 by 12 inches nominal; Model CHA111812.
 - 3) MacLean Highline CVA Series: Fiberglass/polymer concrete splice vault; available Tier 8, Tier 15, and Tier 22 load ratings.
 - (a) 30 by 48 by 18 inches nominal; Model CVA304818.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 083100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 262726.
 - b. Communications Systems Outlets: Comply with Section 271000.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
 - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 - b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
 - 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 260533.13.
 - 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 260529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide required seismic controls in accordance with Section 260548.

3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- M. Install boxes as required to preserve insulation integrity.
- N. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- O. Nonmetallic Floor Boxes: Cut box flush with finished floor after concrete pour.
- P. Underground Boxes/Enclosures:
1. Install enclosure on gravel base, minimum 6 inches deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 4. Provide cast-in-place concrete collar constructed in accordance with Section 033000, minimum 10 inches wide by 12 inches deep, around enclosures that are not located in concrete areas.
 5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- Q. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 078400.
- S. Close unused box openings.
- T. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- U. Provide grounding and bonding in accordance with Section 260526.
- V. Identify boxes in accordance with Section 260553.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 260533.16

SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface raceway systems.
- B. Wireways.
- C. Wall duct.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
 - 1. Includes metal channel (strut) used as raceway.
- C. Section 260533.13 - Conduit for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260539 - Underfloor Raceways for Electrical Systems: Trench duct.
- F. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 262723 - Indoor Service Poles.
- H. Section 262726 - Wiring Devices: Receptacles.
- I. Section 271000 - Structured Cabling: Voice and data jacks.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA PRP 5 - Installation Guidelines for Surface Nonmetallic Raceway; 2015.
- E. UL 5 - Surface Metal Raceways and Fittings; Current Edition, Including All Revisions.

- F. UL 5A - Nonmetallic Surface Raceways and Fittings; Current Edition, Including All Revisions.
- G. UL 111 - Outline of Investigation for Multioutlet Assemblies; Current Edition, Including All Revisions.
- H. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate rough-in locations of outlet boxes provided under Section 260533.16 and conduit provided under Section 260533.13 as required for installation of raceways provided under this section.
 - 3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
 - 4. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install raceways until final surface finishes and painting are complete.
 - 2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.
 - 1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.
- C. Shop Drawings:
 - 1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
 - 2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.
- D. Samples: Three of each type and color of surface raceway system specified, 6 inches in length.

- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 RACEWAY REQUIREMENTS

- A. Provide all components, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

2.2 SURFACE RACEWAY SYSTEMS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. MonoSystems, Inc: www.monosystems.com/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Surface Metal Raceways: Listed and labeled as complying with UL 5.
- C. Surface Nonmetallic Raceways: Listed and labeled as complying with UL 5A.
- D. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

- E. Metal Channel (Strut) Used as Raceway: Comply with Section 260529.
- F. Surface Raceway System:
 - 1. Raceway Type: Single channel, painted steel.
 - 2. Length: As indicated on the drawings.
 - 3. Color: To be selected by Architect.
 - 4. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
 - 5. Integrated Device Provisions:
 - a. Receptacles:
 - 1) Comply with Section 262726, except for finishes.
 - 2) Configuration: As indicated on the drawings.
 - 3) Color: Match raceway.
 - 4) Spacing: As indicated on the drawings.
 - b. Communications Outlets:
 - 1) Voice and Data Jacks: As specified in Section 271000.
 - 2) Voice and Data Jacks: Include provisions for jacks furnished by others.
 - 3) Configuration: As indicated on the drawings.
 - 4) Spacing: As indicated on the drawings.
 - 6. Products:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 WIREWAYS

- A. Manufacturers:
 - 1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
 - 2. Enduro Composites: www.endurocomposites.com/#sle.
 - 3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
 - 4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.
- C. Wireway Type, Unless Otherwise Indicated:
 - 1. Indoor Clean, Dry Locations: NEMA 250, Type 1, painted steel with screw-cover.
 - 2. Outdoor Locations: NEMA 250, Type 3R, painted steel with screw-cover; include provision for padlocking.
- D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

- E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.
- F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.4 WALL DUCT

- A. Manufacturers:
 - 1. Dennis Filges Company, Inc: www.filgesco.com/#sle.
 - 2. Hubbell Incorporated: www.hubbell.com/#sle.
 - 3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 4. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
 - 6. Source Limitations: Where the wall duct system includes connections to trench duct as specified in Section 260539, furnish wall duct and associated components produced by the same manufacturer as the trench duct to be installed.
- B. Description: Metal raceways specifically designed for enclosure of wiring to X-ray machines and similar medical equipment; listed and labeled as complying with UL 870.
- C. Material: Steel, unless otherwise indicated.
- D. Mounting Provisions: Suitable for surface- or flush-mounting as indicated.
- E. Size: As indicated on the drawings.

2.5 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test each production unit for pre-wired surface raceway systems to verify proper wiring.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.
- C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install raceways plumb and level.
- D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.
- E. Secure and support raceways in accordance with Section 260529 at intervals complying with NFPA 70 and manufacturer's requirements.
- F. Close unused raceway openings.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Identify raceways in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect raceways for damage and defects.
- C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.
- D. Correct wiring deficiencies and replace damaged or defective raceways.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 PROTECTION

- A. Protect installed raceways from subsequent construction operations.

END OF SECTION 260533.23

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

1.2 RELATED REQUIREMENTS

- A. Section 014533 - Code-Required Special Inspections and Procedures.
- B. Section 033000 - Cast-in-Place Concrete.
- C. Section 055000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- D. Section 260529 - Hangers and Supports for Electrical Systems.

1.3 DEFINITIONS

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.

- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2014.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; 2015.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2015).
- I. MFMA-4 - Metal Framing Standards Publication; 2004.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
 - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification method for spring element load capacities.
 - 2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
 - 1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
 - 2. Identify mounting conditions required for equipment seismic qualification.
 - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
 - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
 - 6. Indicate locations of seismic separations where applicable.
 - 7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
 - 1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.

- f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
- 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- D. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
 - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- E. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
 - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
 - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2 inch operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation:
 - 1. Transformers:
 - a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
 - b. Floor-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
 - c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
 - d. Suspended Transformers, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 - e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
 - f. Wall-Mounted Transformers, Non-Seismic Applications: Use resilient material isolator mounts.
 - g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
 - h. Minimum Static Deflection:
 - 1) Transformers Mounted on Grade-Level Slabs: 0.25 inch deflection unless otherwise indicated.
 - 2) Transformers Mounted at Above-Grade Levels: 0.5 inch deflection unless otherwise indicated.
 - 2. Engine Generators:

- a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
- b. Non-Seismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
- c. Non-Seismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
- d. Seismic Applications: Use seismic type restrained spring isolators.
- e. Provide vibration-isolated concrete inertia bases where indicated.
- f. Minimum Static Deflection:
 - 1) Generators Mounted on Grade-Level Slabs: 1 inch deflection unless otherwise indicated.
 - 2) Generators Mounted at Above-Grade Levels: 2 inch deflection unless otherwise indicated.

E. Conduit Isolation:

1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
 - a. Minimum Length: 3 feet unless otherwise indicated.
2. Vibration Isolators:
 - a. Provide vibration isolators for conduit supports:
 - 1) Located within 50 feet of connected vibration-isolated equipment where flexible connection to equipment is not possible.
 - 2) For conduits over 2 inch trade size located below or within 50 feet of noise-sensitive areas indicated.
 - b. Minimum Static Deflection:
 - 1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch deflection required.
 - 2) Remainder of Supports: 0.75 inch deflection unless otherwise indicated.
 - c. Suspended Conduits, Non-Seismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
 - d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
 - e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g. walls, floors) arranged to prevent vibration transmission to structure.

2.2 SEISMIC CONTROL REQUIREMENTS

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: As indicated on drawings.
- C. Seismic Qualification of Equipment:
 - 1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (I_p) of 1.5, certifying that equipment will remain operable following a design level earthquake.
 - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
 - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
 - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- D. Premanufactured Modular Electrical Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- E. Seismic Restraints:
 - 1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Electrical components where either of the following apply:
 - (a) The component importance factor (I_p) is 1.0 and the component is positively attached to the structure.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.
 - b. Exemptions for Seismic Design Category D, E, and F:
 - 1) Discrete electrical components that are positively attached to the structure where either of the following apply:
 - (a) The component weighs 400 pounds or less, has a center of mass located 4 feet or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (I_p) is 1.0.
 - (b) The component weighs 20 pounds or less or, in the case of a distributed system, 5 pounds per foot or less.

- c. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
 - 1) Raceways with component importance factor (I_p) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
 - (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds or less.
 - (c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch diameter rod hangers not exceeding 24 inches in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds or less.
 - (d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch or 1/2 inch in diameter not exceeding 12 inches in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds or less.
 - 2) Conduits less than 2-1/2 inch trade size.
- d. Lighting Exemptions, All Seismic Design Categories:
 - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
 - 2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 413.
 - c. FEMA E-74.
 - d. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third party registered professional engineer acceptable to authorities having jurisdiction.

5. Seismic Type Vibration Isolators:
 - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
 6. External Seismic Snubber Assemblies:
 - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
 - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
 7. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
 - c. Use only one restraint system type for a given electrical component or distributed system (e.g. conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
 - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
 - j. Manufacturer's certified seismic restraint design may be submitted as an alternative to project-specific design and documentation, subject to approval of authorities having jurisdiction.
- F. Seismic Attachments:
1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
 3. Do not use power-actuated fasteners.
 4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
 5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
 6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
 3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g. conduit, cable tray); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.
 - d. Anticipated drifts between floors.

2.3 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

- A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 2. Substitutions: See Section 016000 - Product Requirements.

3. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. Vibration-Isolated Concrete Inertia Bases:
 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
 2. Minimum Base Depth: 6 inches.
 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
 5. Concrete: Filled on site with minimum 3000 psi concrete in accordance with Section 033000.

2.4 VIBRATION ISOLATORS

- A. Manufacturers:
 1. Vibration Isolators:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 2. Substitutions: See Section 016000 - Product Requirements.
 3. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
 2. Spring Elements for Spring Isolators:
 - a. Color code or otherwise identify springs to indicate load capacity.
 - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
 - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
 - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
 - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
 - f. Selected to function without undue stress or overloading.
 3. Seismic Snubbing Elements for Seismic Isolators:
 - a. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.

- b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Non-Seismic Applications:
 - 1. Resilient Material Isolator Pads:
 - a. Description: Single or multiple layer pads utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material.
 - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch thickness.
 - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
 - 2. Resilient Material Isolator Mounts, Non-Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material; fail-safe type.
 - 3. Open (Unhoused) Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
 - b. Bottom Load Plate: Non-skid molded elastomeric isolator material or steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - 4. Housed Spring Isolators:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
 - b. Furnished with integral elastomeric snubbing elements, non-adjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
 - c. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - d. Furnished with integral leveling device for positioning and securing supported equipment.
 - 5. Restrained Spring Isolators, Non-Seismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
 - b. Bottom Load Plate: Steel with non-skid elastomeric isolator pad with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
 - 6. Resilient Material Isolator Hangers, Non-Seismic:

- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
- 7. Spring Isolator Hangers, Non-Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
- 8. Combination Resilient Material/Spring Isolator Hangers, Non-Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
- D. Vibration Isolators for Seismic Applications:
 - 1. Resilient Material Isolator Mounts, Seismic:
 - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g. neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
 - 2. Restrained Spring Isolators, Seismic:
 - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g. neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
 - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
 - c. Furnished with integral leveling device for positioning and securing supported equipment.
 - d. Provides constant free and operating height.
 - 3. Resilient Material Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g. neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - 4. Spring Isolator Hangers, Seismic:

- a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
 - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g. neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
 - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short circuiting of isolation.

2.5 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:
 1. External Seismic Snubber Assemblies:
 - a. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.
 - b. Mason Industries: www.mason-ind.com/#sle.
 - c. Vibration Eliminator Company, Inc: www.veco-nyc.com/#sle.
 2. Substitutions: See Section 016000 - Product Requirements.
 3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
 1. Air Gap: Between 0.125 inches and 0.25 inches unless otherwise indicated.
 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch thick; capable of being visually inspected for damage and replaced.

2.6 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:
 1. Seismic Restraint Systems:
 - a. Eaton Corporation: www.eaton.com/#sle.
 - b. Kinetics Noise Control, Inc: www.kineticsnoise.com/#sle.

- c. Mason Industries: www.mason-ind.com/#sle.
- 2. Substitutions: See Section 016000 - Product Requirements.
- 3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
 - 1. Comply with ASCE 19.
 - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 014533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

- D. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
 - 1. Vibration-Isolated Equipment Support Bases:
 - a. Provide specified minimum clearance beneath base.
 - 2. Spring Isolators:
 - a. Position equipment at operating height; provide temporary blocking as required.
 - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
 - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
 - 3. Isolator Hangers:
 - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
 - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
 - 4. Clean debris from beneath vibration-isolated equipment that could cause short circuiting of isolation.
 - 5. Use elastomeric grommets for attachments where required to prevent short circuiting of isolation.
 - 6. Adjust isolators to be free of isolation short circuits during normal operation.
 - 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
 - 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
 - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.

3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
 - a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
 - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install cable restraints for vibration-isolated components slightly slack to prevent short circuiting of isolation.
 - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.
- D. Vibration Isolation Systems:
 1. Verify isolator static deflections.
 2. Verify required clearance beneath vibration-isolated equipment support bases.
 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
 1. Verify snubbing element air gaps.

- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.5 ATTACHMENTS

- A. Statement of special inspections.

END OF SECTION 260548

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 099113 - Exterior Painting.
- B. Section 099123 - Interior Painting.
- C. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- D. Section 260536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- E. Section 260573 - Power System Studies: Arc flash hazard warning labels.
- F. Section 262300 - Low-Voltage Switchgear: Factory-installed mimic bus.
- G. Section 262726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
- H. Section 263100 - Photovoltaic Collectors: Additional identification requirements for photovoltaic systems.
- I. Section 271000 - Structured Cabling: Identification for communications cabling and devices.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.
- E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- D. Samples:
 - 1. Identification Nameplates: One of each type and color specified.
 - 2. Warning Signs and Labels: One of each type and legend specified.
- E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Switchgear:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main and tie devices.
 - 5) Use identification nameplate to identify load(s) served for each branch device.
Do not identify spares and spaces.
 - 6) See Section 262300 for factory-installed mimic bus.
 - b. Switchboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device.
Do not identify spares and spaces.
 - c. Motor Control Centers:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Use identification nameplate to identify main overcurrent protective device.
 - 5) Use identification nameplate to identify load(s) served for each branch device.
Do not identify spares and spaces.
 - d. Panelboards:

- 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
- e. Transformers:
- 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify load(s) served. Include location when not within sight of equipment.
- f. Enclosed switches, circuit breakers, and motor controllers:
- 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
- g. Busway:
- 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Provide identification at maximum intervals of 40 feet.
 - 5) Use identification nameplate to identify load(s) served for each plug-in unit. Include location when not within sight of equipment.
- h. Time Switches:
- 1) Identify load(s) served and associated circuits controlled. Include location.
- i. Enclosed Contactors:
- 1) Identify ampere rating.

- 2) Identify voltage and phase.
- 3) Identify configuration, e.g., E.O.E.H. (electrically operated, electrically held) or E.O.M.H. (electrically operated, mechanically held).
- 4) Identify coil voltage.
- 5) Identify load(s) and associated circuits controlled. Include location.
- j. Centralized Emergency Lighting Inverters:
 - 1) Identify input and output voltage and phase.
 - 2) Identify power source and circuit number for normal power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location.
- k. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
- l. Electricity Meters:
 - 1) Identify load(s) metered.
2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
5. Use identification nameplate to identify equipment utilizing series ratings, where permitted, in accordance with NFPA 70.

6. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
 7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.
 9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
 10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
 11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with Section 099123 and 099113.
 12. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Elevator control panels.
 - c. Industrial machinery.
 13. Arc Flash Hazard Warning Labels: Comply with Section 260573.
 14. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
 15. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 16. Use warning labels to identify electrical hazards for equipment, compartments, and enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
 17. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.
- C. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 260519.
 2. Identification for Communications Conductors and Cables: Comply with Section 271000.

3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 - d. In cable tray, at maximum intervals of 20 feet.
 5. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
 6. Use underground warning tape to identify direct buried cables.
- D. Identification for Raceways:
1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
 2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
 - a. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
 - 1) Color Code:
 - (a) Emergency Power System: Red.
 - 2) Field-Painting: Comply with Section 099123 and 099113.
 - 3) Vinyl Color Coding Electrical Tape: Comply with Section 260519.
 3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 5. Use underground warning tape to identify underground raceways.
 6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Cable Tray: Comply with Section 260536.
- F. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers or color coded boxes to identify systems other than normal power system.
 - a. Color-Coded Boxes: Field-painted in accordance with Section 099123 and 099113 per the same color code used for raceways.

3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - a. For exposed boxes in public areas, use only identification labels.
4. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

G. Identification for Devices:

1. Identification for Communications Devices: Comply with Section 271000.
2. Wiring Device and Wallplate Finishes: Comply with Section 262726.
3. Factory Pre-Marked Wallplates: Comply with Section 262726.
4. Use identification label to identify fire alarm system devices.
 - a. For devices concealed above suspended ceilings, provide additional identification on ceiling tile below device location.
5. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
6. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
7. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.

H. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

I. Identification for Photovoltaic Systems: Comply with Section 263100

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co{CH#275749}: www.kolbipipemarkers.com/#sle.
 - c. Seton Identification Products: www.seton.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
6. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Manufacturers:
 - a. Brady Corporation: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - 2) Fire Alarm System: Identify with text "FIRE ALARM".
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - c. Other Information: 1/4 inch.
 - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
 - c. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.

3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - 1) Provide white text on red background for general information or operational instructions for emergency systems.
 - 2) Provide white text on red background for general information or operational instructions for fire alarm systems.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Load controlled or other designation indicated.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Black text on clear background.
- H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Designation indicated and device zone or address.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 3/16 inch.
 5. Color: Red text on white background.

2.3 WIRE AND CABLE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. HellermannTyton: www.hellermannntyton.com/#sle.

3. Panduit Corp: www.panduit.com/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Manufacturers:
1. Brady Corporation: www.bradyid.com/#sle.
 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3.
 4. Seton Identification Products: www.seton.com/#sle.
- B. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- C. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- D. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
 2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- E. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
- F. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
- B. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
 - 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- C. Non-detectable Type Tape: 6 inches wide, with minimum thickness of 4 mil.
- D. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- E. Legend: Type of service, continuously repeated over full length of tape.
- F. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 FLOOR MARKING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com/#sle.
 - 2. Brimar Industries, Inc: www.brimar.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
- B. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.7 WARNING SIGNS AND LABELS

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.brimar.com/#sle.
 - 2. Clarion Safety Systems, LLC: www.clarionsafety.com/#sle.
 - 3. Seton Identification Products: www.seton.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- C. Warning Signs:
 - 1. Materials:

- a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- D. Warning Labels:
1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment: Enclosure front.
 2. Flush-Mounted Equipment: Inside of equipment door.
 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment: Legible from the floor or working platform.
 5. Branch Devices: Adjacent to device.
 6. Interior Components: Legible from the point of access.
 7. Conduits: Legible from the floor.
 8. Boxes: Outside face of cover.
 9. Conductors and Cables: Legible from the point of access.
 10. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

- F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 260553

SECTION 260573 - POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 261116 - Secondary Unit Substations.
- C. Section 261300 - Medium-Voltage Switchgear.
- D. Section 261321 - Air Interrupter Switches.
- E. Section 261839 - Medium-Voltage Motor Controllers.
- F. Section 262100 - Low-Voltage Electrical Service Entrance.
 - 1. Includes Utility Company contact information.
- G. Section 262300 - Low-Voltage Switchgear.
- H. Section 262413 - Switchboards.
- I. Section 262416 - Panelboards.
- J. Section 262419 - Motor-Control Centers.
- K. Section 262513 - Low-Voltage Busways.
- L. Section 262813 - Fuses.
- M. Section 262816.13 - Enclosed Circuit Breakers.
- N. Section 262816.16 - Enclosed Switches.

- O. Section 262913 - Enclosed Controllers.
- P. Section 263323 - Central Battery Equipment.
- Q. Section 263533.16 - Low-Voltage Power Factor Correction Equipment.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011 (Reaffirmed 2017).
- B. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaff 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001.
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations; 2002, including 1584a (2004) and 1584b (2011) amendments.
- G. NEMA MG 1 - Motors and Generators; 2021.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
 - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 3. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

- B. Pre-Study Meeting: Conduct meeting with Owner to discuss system operating modes and conditions to be considered in studies.
- C. Sequencing:
 - 1. Submit study reports prior to or concurrent with product submittals.
 - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
 - 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
- D. Scheduling:
 - 1. Arrange access to existing facility for data collection with Owner.
 - 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Field testing agency's qualifications.
- D. Study reports, stamped or sealed and signed by study preparer.
- E. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
 - 1. Include characteristic time-current trip curves for protective devices.
 - 2. Include impedance data for busway.
 - 3. Include impedance data for engine generators.
 - 4. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 5. Include documentation of listed series ratings upon request.
 - 6. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- F. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- G. Site-specific arc flash hazard warning labels.
- H. Field quality control reports.

- I. Certification that field adjustable protective devices have been set in accordance with requirements of studies.
- J. Project Record Documents: Revise studies as required to reflect as-built conditions.
 - 1. Include hard copies with operation and maintenance data submittals.
 - 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.6 POWER SYSTEM STUDIES

- A. Scope of Studies:
 - 1. Perform analysis of new electrical distribution system as indicated on drawings.
 - 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 - 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a. Known Operating Modes:
 - 1) Utility as source.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - 2) Utility Company: See Section 262100 for Utility Company contact information.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:

- 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
- 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
- f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
- g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
2. Existing Installations:
 - a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
 - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
 - c. Available Existing Data:
- D. Short-Circuit Study:
 1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
 - a. Maximum utility fault currents.
 - b. Maximum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
 1. Comply with applicable portions of IEEE 242 and IEEE 399.
 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
 3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.
- F. Arc Flash and Shock Risk Assessment:
 1. Comply with NFPA 70E.
 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.

- a. To clarify IEEE 1584 statement that "equipment below 240 V need not be considered unless it involves at least one 125 kVA or larger low-impedance transformer in its immediate power supply" for purposes of studies, study preparer to include equipment rated less than 240 V fed by transformers less than 125 kVA in calculations.
 - b. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
 - c. For single-phase systems, study preparer to perform calculations assuming three-phase system in accordance with IEEE 1584 yielding conservative results.
3. For equipment with main devices mounted in separate compartmentalized sections, perform calculations on both the line and load side of the main device.
4. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:

1. General Requirements:
 - a. Identify date of study and study preparer.
 - b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
2. Short-Circuit Study:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
 - 2) Fault point X/R ratio.
 - 3) Associated equipment short circuit current ratings.
 - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
3. Protective Device Coordination Study:
 - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.

- 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
- 3) Conductors: Damage curves.
- 4) Transformers: Inrush points and damage curves.
- 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
- 6) Motors: Full load current, starting curves, and damage curves.
- 7) Capacitors: Full load current and damage curves.
- c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
 - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
- d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
 - c. Identify locations where the calculated maximum incident energy exceeds 40 calories per sq cm.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in the preparation of studies of similar type and complexity using specified computer software.
 - 1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
 - 2. Study preparer may be employed by field testing agency.
 - 3. Acceptable Study Preparers:
- B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years experience; NETA Accredited Company.
 - 1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.
- C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 - 1. Acceptable Software Products:
 - a. EasyPower LLC: www.easypower.com/#sle.
 - b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
 - c. Power Analytics Corporation: www.poweranalytics.com/#sle.
 - d. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 - 1. Materials: Comply with Section 260553.
 - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
 - d. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.

- 6) Restricted approach boundary.
- 7) Equipment identification.
- 8) Date calculations were performed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 260553.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide the services of field testing agency or equipment manufacturer's representative to perform inspection, testing, and adjusting.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Adjust equipment and protective devices for compliance with studies and recommended settings.
- E. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.
- F. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.3 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
 - 1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of eight hours of training.
 - 3. Instructor: Representative of entity performing study.
 - 4. Location: At project site.

3.4 ATTACHMENTS

- A. Previous studies.
- B. Existing drawings.

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END OF SECTION 260573

SECTION 260583 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260533.13 - Conduit for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 262726 - Wiring Devices.
- E. Section 262816.16 - Enclosed Switches.
- F. Section 262913 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 262816.16 and in individual equipment sections.
- C. Wiring Devices: As specified in Section 262726.
- D. Flexible Conduit: As specified in Section 260533.13.
- E. Wire and Cable: As specified in Section 260519.
- F. Boxes: As specified in Section 260533.16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 260583

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SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.
- B. Outdoor motion sensors.
- C. Time switches.
- D. In-wall time switches.
- E. In-wall interval timers.
- F. Outdoor photo controls.
- G. Daylighting controls.
- H. Lighting contactors.
- I. Control accessories.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems
- C. Section 260533.16 - Boxes for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260573 - Power System Studies.
- F. Section 260918 - Remote Control Switching Devices: Remotely controlled devices for lighting control, including networked lighting controls, programmable relay panels, and remote control switching relays.
- G. Section 262726 - Wiring Devices: Devices for manual control of lighting, including wall switches.
 - 1. Includes finish requirements for wall controls specified in this section.
 - 2. Includes accessory receptacles, switches, dimmers and wall plates, to match lighting controls specified in this section.

- H. Section 262813 - Fuses.
- I. Section 262913 - Enclosed Controllers : General purpose contactors.
- J. Section 265100 - Interior Lighting.
- K. Section 265561 - Theatrical Lighting: Controls for stage lighting units.
- L. Section 265600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
- C. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.
- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- I. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2000 (R2010).
- J. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (R2011).
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 773 - Plug-in, Locking Type Photocontrols for Use with Area Lighting; Current Edition, Including All Revisions.
- M. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

- N. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- O. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.
- P. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- Q. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.
- R. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contractors and Motor-starters - Electromechanical Contractors and Motor-starters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
 - 3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
 - 4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 - 5. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Locking Receptacle-Mounted Outdoor Photo Controls: Five percent of total quantity installed for each type, but not less than two of each type.
 3. Indicating Lights: Two of each different type.
- H. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- 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 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.
- C. Provide five year manufacturer warranty for utility grade locking receptacle-mounted outdoor photo controls.
- D. Provide two year manufacturer warranty for all daylighting controls.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Ballasts/Drivers: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 3. Sensor Switch Inc: www.sensorswitch.com/#sle.
 - 4. WattStopper: www.wattstopper.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
 - 6. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
 - 2. Sensor Technology:
 - a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.
 - b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.
 - c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.

- d. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Adaptive Technology: Field selectable; capable of self-adjusting sensitivity and time delay according to conditions.
 10. Integral Photocell: For field selectable and adjustable inhibition of automatic turn-on of load when ambient lighting is above the selected level.
 11. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
 12. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on drawings.
 13. Isolated Relay for Low Voltage Occupancy Sensors: SPDT dry contacts, ratings as required for interface with system indicated.
 14. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
 15. Wireless Sensors:
 - a. RF Range: 30 feet through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.
- C. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide line voltage units with self-contained relay.

- c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.
 - d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - f. Provide selectable audible alert to notify occupant of impending load turn-off.
 - g. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
 - h. Provide vandal resistant lenses for passive infrared (PIR) and dual technology wall switch occupancy sensors where indicated.
2. Passive Infrared (PIR) Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
- D. Wall Dimmer Occupancy Sensors:
- 1. General Requirements:
 - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability , and no leakage current to load in off mode.
 - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
 - c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
 - d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
 - e. Provide field adjustable dimming preset for occupied state.
 - f. Provide fade-to-off operation to notify occupant of impending load turn-off.
 - g. Finish: Match finishes specified for wiring devices in Section 262726, unless otherwise indicated.
 - 2. Passive Infrared (PIR) Wall Dimmer Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.
 - a. Products:
 - 1) Lutron Maestro C.L Sensor Dimmer Series; www.lutron.com/#sle.
 - 2) Lutron Maestro Occupancy Sensor Dimmer Series; www.lutron.com/#sle.
 - 3) Lutron Maestro 0-10V Dimmer Sensor Series; www.lutron.com/#sle.
 - 4) Substitutions: See Section 016000 - Product Requirements.

E. Ceiling Mounted Occupancy Sensors:

1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 - e. Finish: White unless otherwise indicated.
2. Passive Infrared (PIR) Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Lutron LOS-CIR Series; www.lutron.com/#sle.
 - (b) Lutron Radio Powr Savr Wireless Sensors; www.lutron.com/#sle.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
3. Ultrasonic Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 500 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Lutron LOS-CUS Series; www.lutron.com/#sle.
 - b. Medium Range Sensors: Capable of detecting motion within an area of 1,000 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Lutron LOS-CUS Series; www.lutron.com/#sle.
 - c. Extended Range Sensors: Capable of detecting motion within an area of 2,000 square feet at a mounting height of 9 feet.
 - 1) Products:
 - (a) Lutron LOS-CUS Series; www.lutron.com/#sle.
4. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Lutron LOS-CDT Series; www.lutron.com/#sle.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - 1) Products:
 - (a) Lutron LOS-CDT Series; www.lutron.com/#sle.
5. Passive Infrared/Acoustic Dual Technology Ceiling Mounted Occupancy Sensors:

- a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.
 - b. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet.
- F. Directional Occupancy Sensors:
 1. All Directional Occupancy Sensors: Designed for wall or ceiling mounting, with integral swivel for field adjustment of motion detection coverage.
 - a. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - b. Provide field selectable setting for disabling LED motion detector visual indicator.
 - c. Finish: White unless otherwise indicated.
 2. Passive Infrared (PIR) Directional Occupancy Sensors:
 - a. Standard Range Sensors: Capable of detecting motion within a distance of 40 feet at a mounting height of 10 feet.
- G. Luminaire Mounted Occupancy Sensors: Designed for direct luminaire installation and control, suitable for use with specified luminaires.
- H. Power Packs for Low Voltage Occupancy Sensors:
 1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
 2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 3. Input Supply Voltage: Dual rated for 120/277 V ac.
 4. Load Rating: As required to control the load indicated on drawings.
- I. Power Packs for Wireless Occupancy Sensors:
 1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.
 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 3. Load Rating: As required to control the load indicated on drawings.

2.3 OUTDOOR MOTION SENSORS

- A. Description: Factory-assembled wet location listed device suitable for wall or ceiling/eave mounting, with integral swivel for field adjustment of coverage, capable of detecting motion for automatic control of load indicated.
- B. Sensor Technology: Passive Infrared (PIR) designed to detect occupancy by sensing movement of thermal energy between zones.

- C. Operation: Unless otherwise indicated, motion sensor to turn load on when motion is detected and to turn load off when no motion is detected during an adjustable turn-off delay time interval.
- D. Turn-Off Delay: Field adjustable, with time delay settings available up to 15 minutes.
- E. Integral Photocell: For dusk to dawn operation.
- F. Manual Override: Activated by switching power off to unit and then back on.
- G. Load Rating: 1,000 W incandescent and fluorescent load at 120 V ac.
- H. Coverage: Capable of detecting motion within a distance of 50 feet at a mounting height of 8 feet, with a field of view of 270 degrees.

2.4 TIME SWITCHES

- A. Manufacturers:
 - 1. Intermatic, Inc: www.intermatic.com/#sle.
 - 2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.
 - 4. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.
- B. Digital Electronic Time Switches:
 - 1. Description: Factory-assembled solid state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
 - 2. Program Capability:
 - a. 24-Hour Time Switches: Single channel, with same schedule for each day of the week and skip-a-day feature to omit selected days.
 - b. 7-Day Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days.
 - c. Astronomic Time Switches: Single channel, capable of different schedule for each day of the week with additional holiday schedule available to override normal schedule for selected days and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.
 - 3. Schedule Capacity: Not less than 16 programmable on/off operations.
 - 4. Provide automatic daylight savings time and leap year compensation.
 - 5. Provide power outage backup to retain programming and maintain clock.
 - 6. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
 - 7. Input Supply Voltage: As indicated on the drawings.
 - 8. Output Switch Configuration: As required to control the load indicated on drawings.

9. Output Switch Contact Ratings: As required to control the load indicated on drawings.
10. Provide lockable enclosure; environmental type per NEMA 250 as specified for the following installation locations:

2.5 IN-WALL TIME SWITCHES

2.6 IN-WALL INTERVAL TIMERS

2.7 OUTDOOR PHOTO CONTROLS

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.
2. Tork, a division of NSI Industries LLC: www.tork.com/#sle.

B. Stem-Mounted Outdoor Photo Controls:

1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.
2. Housing: Weatherproof, impact resistant polycarbonate.
3. Photo Sensor: Cadmium sulfide.
4. Provide external sliding shield for field adjustment of light level activation.
5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.
6. Voltage: As required to control the load indicated on the drawings.
7. Failure Mode: Fails to the on position.
8. Load Rating: As required to control the load indicated on the drawings.
9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Locking Receptacle-Mounted Outdoor Photo Controls

1. Description: Plug-in locking type photo control unit complying with ANSI C136.10 for mounting on a compatible receptacle, listed and labeled as complying with UL 773.
2. Housing: Weatherproof, impact resistant UV stabilized polypropylene, color to be selected.
3. Photo Sensor: Cadmium sulfide.
4. Light Level Activation: 1 to 3 footcandles turn-on and 1.5 to 1 turn-off to turn-on ratio with instant turn-on and delayed turn-off.
5. Voltage: As required to control the load indicated on the drawings.
6. Failure Mode: Fails to the on position.
7. Load Rating: As required to control the load indicated on the drawings.
8. Surge Protection: 160 joule metal oxide varistor.
9. Provide the following accessories where indicated or as required to complete installation:
 - a. Receptacle: Complying with ANSI C136.10.
 - b. Mounting Bracket.
 - c. Shorting Cap: Suitable for replacing locking photo control to complete circuit.

2.8 DAYLIGHTING CONTROLS

- A. Manufacturers:
1. Hubbell Control Solutions: www.hubbell.com/hubbellcontrolsolutions/en/#sle.
 2. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 3. Sensor Switch Inc: www.sensorswitch.com/#sle.
 4. WattStopper: www.wattstopper.com/#sle.
- B. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.
- C. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
 2. Sensor Range:
 - a. Indoor Photo Sensors: 5 to 100 footcandles.
 - b. Outdoor Photo Sensors: 5 to 250 footcandles.
 - c. Atrium Photo Sensors: 200 to 2,500 footcandles.
 - d. Skylight Photo Sensors: 1,000 to 6,000 footcandles.
 - e. Open Loop Photo Sensors: 3 to 6,000 footcandles.
 3. Finish: White unless otherwise indicated.
 4. Where wired sensors are indicated, wireless sensors are acceptable provided that all components and wiring modifications necessary for proper operation are included.
 5. Wireless Daylighting Control Photo Sensors:
 - a. RF Range: 30 feet through typical construction materials.
 - b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.
 - c. Power: Battery-operated with minimum ten-year battery life.
 - d. Products:
 - 1) Lutron Radio Powr Savr Wireless Sensors; www.lutron.com/#sle.
- D. Dimming Photo Sensors: Photo sensor units with integral controller compatible with specified dimming ballasts, for direct continuous dimming of up to 50 ballasts.
- E. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.

2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
 3. Control Capability:
 - a. Single Zone Switching Modules: Capable of controlling one programmable channel.
 - b. Multi-Zone Switching Modules: Capable of controlling up to three separately programmable channels.
- F. Daylighting Control Switching Modules for Wireless Sensors:
1. Description: Plenum rated, self-contained relay compatible with specified wireless photo sensors for switching of line voltage loads in response to changes in measured light levels according to selected settings.
 2. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
 3. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
 4. Control Capability: Capable of controlling one programmable channel.
 5. Input Supply Voltage: Dual rated for 120/277 V ac.
- G. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
 2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
 3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
 4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.
- H. Daylighting Control Dimming Modules for Wireless Sensors:
1. Description: Plenum rated control unit compatible with specified wireless photo sensors and with specified dimming ballasts, for continuous dimming of compatible dimming ballasts in response to changes in measured light levels according to selected settings.
 2. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
 3. Load to be turned off when available daylight is sufficient to fully dim the load, after the selected time delay.
 4. Control Capability: Capable of controlling up to 32 ballasts with up to two separately programmable daylighting zones.
- I. Power Packs for Low Voltage Daylighting Control Modules:

1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
 2. Input Supply Voltage: Dual rated for 120/277 V ac.
 3. Load Ratings: As required to control the load indicated on drawings.
- J. Accessories:
1. Where indicated, provide compatible accessory wall switches for manual override control.
 2. Where indicated, provide compatible accessory wireless controls for manual override control.
 - a. Products:
 - 1) Lutron Pico Wireless Controls; www.lutron.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of lighting control devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
 - b. In-Wall Time Switches: 48 inches above finished floor.
 - c. In-Wall Interval Timers: 48 inches above finished floor.
 - 2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
 - 3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 262726.
- G. Provide required supports in accordance with Section 260529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Identify lighting control devices in accordance with Section 260553.
- J. Occupancy Sensor Locations:
 - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.
- K. Outdoor Photo Control Locations:
 - 1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.

2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by the photo control itself.
- L. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.
- M. Daylighting Control Photo Sensor Locations:
 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
 2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
 3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.
- N. Combination Enclosed Lighting Contactors:
 1. Except where indicated to be mounted adjacent to the equipment they supply, mount lighting contactors such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- O. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- P. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.
- Q. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

- F. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.
- G. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.
- E. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.
- F. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect.
- G. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

- A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.8 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.

- C. Demonstration: Demonstrate proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION 260923

SECTION 260924 – NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Network lighting control system and components:
 - a. Touch panel controls.
 - b. Lighting management panels
 - c. Lighting management modules
 - d. Low voltage wall stations
 - e. Power interfaces
 - f. Wired sensors
- B. Provide a complete fully operational Title 24 compliant digital networked lighting control system for all interior and exterior spaces. Provide all necessary controls and components for this system, regardless of if shown on construction documents or not.
- C. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.
- D. The lighting control system shall interface with the Energy Management System (EMS) to provide occupant sensing for HVAC setback controls, data logging and reporting. Where necessary, provide room level controls (relays and digital interface) for direct connection to HVAC local controls.
- E. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed). Specific dimmers will be capable of “dimming lights to off.”
- F. All system devices shall be networked together, enabling digital communication between devices, and shall be individually addressed.
- G. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity, even if network connectivity to the greater system is lost.
- H. The system architecture shall facilitate remote operation via a computer connection.
- I. The system shall not require any centrally hardwired switching equipment.
- J. Network lighting control systems shall provide all relay on/off control for all exterior lighting fixtures and circuits.

- K. Reference to LCP (Lighting Control Panel) shall be interpreted to mean Network Lighting Controls. Relays, controllers, bridge network controls shall be in a panel, LCP

1.2 RELATED DOCUMENTS

- A. Section 262726 Wiring Devices
- B. Section 265100 Interior Lighting Fixtures
- C. Section 265600 Exterior Lighting.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of sensors and wall controls with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate the placement of wall controls with actual installed door swings.
 - 3. Coordinate the placement of daylight sensors with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
 - 4. Where motorized window treatments are to be controlled by the lighting control system provided under this section, coordinate the work with other trades to provide compatible products.
 - 5. Coordinate the work to provide luminaires and lamps compatible with the lighting controls to be installed.
 - 6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Pre-Wire Meeting: Conduct on-site meetings with lighting control system manufacturer prior to commencing work as part of manufacturer's standard startup services. Manufacturer to review with installer:
 - 1. Low voltage wiring requirements.
 - 2. Separation of power and low voltage/data wiring.
 - 3. Wire labeling.
 - 4. Lighting management hub locations and installation.
 - 5. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", sensor locations to be reviewed in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
 - 6. Control locations.
 - 7. Computer jack locations.

8. Load circuit wiring.
9. Network wiring requirements.
10. Connections to other equipment and other Lutron equipment.
11. Installer responsibilities.
12. Power panel locations.

C. Sequencing:

1. Do not install sensors and wall controls until the final surface finishes and painting are complete.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Design Documents: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide plans indicating occupancy/vacancy and/or daylight sensor locations.
- C. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 1. Occupancy/Vacancy Sensors: Include detailed basic motion detection coverage range diagrams.
- D. Shop Drawings:
 1. Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
 2. Provide Title 24 compliant detailed floor plans showing location and types of sensors, control modules, low voltage and line voltage wiring, pushbutton stations, floor controllers, photo sensors, dimming zones and controls and all systems for a code compliant installation.
 3. Provide detailed sequence of operations describing system functions.
- E. Samples:
 1. Wall Controls:
 - a. Show available color and finish selections.
 - b. Provide one sample(s) for each product proposed for substitution upon request.
 2. Sensors: Provide one sample(s) for each product proposed for substitution upon request.
- F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- G. System Performance-Verification Documentation: Include as part of the base bid additional costs for manufacturer's enhanced documentation detailing start-up performance-verification procedures and functional tests performed along with test results.
- H. Title 24 Acceptance Testing Documentation: Submit Certification of Acceptance and associated documentation for lighting control acceptance testing performed in accordance with CAL TITLE 24 P6, as specified in Part 3 under "COMMISSIONING".
- I. Project Record Documents: Record actual installed locations and settings for lighting control system components.
- J. Operation and Maintenance Data: Include detailed information on lighting control system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
- K. Warranty: Submit sample of manufacturer's Warranty or Enhanced Warranty as specified in Part 1 under "WARRANTY". Submit documentation of final execution completed in Contractor's name and registered with manufacturer.
- L. Software: One copy of software provided under this section.

1.5 QUALITY ASSURANCE

- A. All steps in sensor manufacturing process shall occur in North America, including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
- B. All components and the manufacturing facility where the product was manufactured must be RoHS compliant.
- C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40-degree Fahrenheit (and Celsius) operation.
- D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.
- E. Conform to requirements of CEC.
- F. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- G. Manufacturer Qualifications:
 - 1. Company with not less than ten years of experience manufacturing lighting control systems of similar complexity to specified system.
 - 2. Registered to ISO 9001, including in-house engineering for product design activities.
 - 3. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

- H. Title 24 Acceptance Testing Technician Qualifications: Certified by a California approved Acceptance Test Technician Certification Provider (ATTCP) as an Acceptance Test Technicians (ATTs) in accordance with CAL TITLE 24 P6.
- I. Maintenance Contractor Qualifications: Manufacturer's authorized service representative.

1.6 PROJECT CONDITIONS

- A. Only install equipment after the following site conditions are maintained:
 - 1. Ambient Temperature 14 to 105 degrees F (-10 to 40 degrees C)
 - 2. Relative Humidity less than 90% non-condensing
- B. Standard electrical enclosures are permanently installed
- C. Equipment is protected from dust, debris, and moisture.

1.7 WARRANTY

- A. Five (5) year 100% labor and parts replacement.

1.8 MAINTENANCE & SUSTAINABILITY

- A. Provide new parts, upgrades, and/or replacements available for a minimum of 5 years available to the end user.
- B. Provide free telephone technical support.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design Manufacturer: Acuity Brands nLight ; www.acuitybrands.com.
 - 1. Acceptable Manufacturers:
 - a. nLight Lighting Control System. (No Substitution. District request).
 - b. Products by listed manufacturers are subject to compliance with specified requirements and prior approval of Architect.
 - 2. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS

- A. Sensor Layout and Tuning: Include as part of the base bid additional costs for Lighting Control Manufacturer's Sensor Layout and Tuning service; By system manufacture:

1. Lighting Control Manufacturer to take full responsibility for wired or wireless sensor layout and performance for sensors provided by Lighting Control Manufacturer.
2. Lighting Control Manufacturer to analyze the reflected ceiling plans, via supplied electronic AutoCAD format, and design a detailed sensor layout that provides adequate occupancy sensor coverage and ensures occupancy and daylight sensor performance per agreed upon sequence of operations. Contractor to utilize the layouts for sensor placement.
3. During startup, Lighting Control Manufacturer to direct Contractor regarding sensor relocation, as required, should conditions require a deviation from locations specified in the drawings.
4. Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits, within one calendar year from Date of Substantial Completion to fine-tune sensor calibration per the agreed upon sequence of operations.

2.3 SYSTEM REQUIREMENTS

- A. System shall have an architecture that is based upon three main concepts: 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time-based operation.
- B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
- C. System may interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section).
- D. Intelligent lighting control devices shall communicate digitally, require <7 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.
- E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher-level network backbone.
- F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.
- G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.
- H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

- I. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.
- J. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.
- K. System shall use “bridge” devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing system wiring requirements.
- L. Auxiliary relay (dry contact relay) shall be integrated in all ceiling mounted occupancy sensors, in order to provide space occupancy status to HVAC system.

2.4 INDIVIDUAL DEVICE SPECIFICATIONS

- A. Control module (gateway nECY)
 - 1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet network.
 - 2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
 - 3. Control device shall have three RJ-45 ports for connection to the graphic touch screen, other backbone devices bridges) or directly to lighting control devices (upto 128 per port).
 - 4. Device shall automatically detect all devices downstream of it.
 - 5. Device shall have a standard and astronomical internal time clock.
 - 6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
 - 7. Device shall have a USB port
 - 8. Each control gateway device shall be capable of linking 1500 devices to the management software, with reduced memory version capable of support up to 400 devices.
 - 9. Device shall be capable of using a dedicated static or DHCP assigned IP address.
 - 10. Device shall have integral BACNET communication capability.
- B. Networked system occupancy sensors
 - 1. Occupancy sensors shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
 - 2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.

3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional "dual" technology shall be used.
 4. Dual technology sensors shall have one of their two technologies that do not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants.
 5. Sensors shall be available in multiple lens options which are customized for specific applications.
 6. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
 7. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
 8. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
 9. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
 10. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
 11. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
 12. Wall switch sensors must meet CEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- C. Wall switch sensors shall be available with raise/lower dimming adjustment controls.
- D. Networked system daylight (photocell and/or dimming) sensors
1. Photocell shall provide for an on/off set-point, and a dead band to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
 2. Photocell and dimming sensor's set-point and dead band shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.
 3. Dead band setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
 4. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

5. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
6. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.

E. Networked System Power (Relay) Packs

1. Power Packs shall incorporate one Class 1 relay, a 0-10 VDC dimming output, and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay and 0-10 VDC or line voltage dimming output but shall not be required to contribute system power. Power Supplies shall provide system power only but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
7. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).
8. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
9. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
10. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
11. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
12. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.
13. Power (Secondary) Packs shall be available that provide up to 20 Amps switching of general purposed receptacle (plug-load) control.

F. Networked System Relay & Dimming Panels

1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.

G. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
3. All devices shall have two RJ-45 ports.
4. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
5. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
6. Devices with mechanical pushbuttons shall provide tactile and LED user feedback.
7. Devices with mechanical pushbuttons shall be made available with custom button labeling.
8. Devices with a single "on" button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

H. Networked System Graphic Wall Station

1. Device shall have a 3.5" full color touch screen for selecting up to 16 programmable lighting control preset scenes or acting as up to 16 on/off/dim control switches.
 - a. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
 - 1) Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
 - a) Device shall enable user supplied .jpg screen saver image to be uploaded.
 - (1) Device shall surface mount to single-gang switch box.
 - (2) Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply.
 - (3) Device shall have a micro-USB style connector for local computer connectivity.
 - (4) Device shall have two RJ-45 ports for communication

I. Networked System Scene Controllers

1. Device shall have two, three, four, or eight buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Devices shall be available in four colors (Ivory, White, Light Almond, Gray). Color selection shall be by architect and will vary with space.
3. Device shall recess into single-gang switch box and fit a standard GFI opening.
4. Devices shall provide LED user feedback.
5. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
6. All devices shall have two RJ-45 ports.
7. The device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
8. Device shall be capable of selecting a lighting profile to be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
9. Device shall have LEDs indicating current selection.

J. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be capable of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.5 CONTROL STATIONS

- A. Provide control stations with configuration as indicated or as required to control the loads as indicated.
- B. Wired Control Stations:
1. General Requirements:
 - a. Power: Class 2 (low voltage).
 - b. UL listed.
 - c. Provide faceplates with concealed mounting hardware.
 - d. Borders, logos, and graduations to use laser engraving or silk-screened graphic process that chemically bonds graphics to faceplate, resistant to removal by scratching and cleaning.

- e. Finish: As specified for wall controls in "Device Finishes" under DIGITAL NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS article above.
- 2. Multi-Scene Wired Control:
 - a. General Requirements:
 - 1) Allows control of any devices part of the lighting control system.
 - 2) Allows for easy reprogramming without replacing unit.
 - 3) Replacement of units does not require reprogramming.
 - 4) Communications: Utilize RS485 wiring for low-voltage communications link.
 - 5) Engrave keypads with button, zone, and scene descriptions to be selected by Architect.
 - 6) Software Configuration:
 - a) Customizable control station device button functionality:
 - b) Buttons can be programmed to perform single defined action.
 - c) Buttons can be programmed to perform defined action on press and defined action on release.
 - d) Buttons can be programmed using conditional logic off of a state variable such as time of day or partition status.
 - e) Buttons can be programmed to perform automatic sequence of defined actions.
 - f) Capable of deactivating select keypads to prevent accidental changes to light levels.
 - g) Buttons can be programmed for raise/lower of defined loads.
 - h) Buttons can be programmed to toggle defined set of loads on/off.
 - 7) Status LEDs:
 - a) Upon button press, LEDs to immediately illuminate.
 - b) LEDs to reflect the true system status. LEDs to remain illuminated if the button press was properly processed or LEDs to turn off if the button press was not processed.
 - c) Support logic that defines when LED is illuminated:
 - d) Scene logic (logic is true when all zones are at defined levels).
 - e) Room logic (logic is true when at least one zone is on).
 - f) Pathway logic (logic is true when at least one zone is on).
 - g) Last scene (logic is true when spaces are in defined scenes).
 - b. Wired Keypads:
 - 1) Style: Architectural Non-Insert Style.
 - 2) Mounting: Wall box or low voltage mounting bracket; provide wall plates with concealed mounting hardware.
 - 3) Button/Engraving Backlighting:
 - a) Utilize backlighting for buttons and associated engraving to provide readability under all light conditions.
 - b) Backlight intensity adjustable via programming software.

- 4) Design keypads to allow field-customization of button color, configuration, and engraving using field-changeable replacement kits.
 - 5) Contact Closure Interface: Provide two contact closure inputs on back of unit which provide independent functions from front buttons; accepts both momentary and maintained contact closures.
 - 6) Terminal block inputs to be over-voltage and mis wire-protected against reversals and shorts.
 - 7) Provide integral infrared receiver for personal control where indicated.
3. Single-Scene or Zoned Wired Control:
 - a. Turn an individual fixture or group of fixtures on and off.
 - b. Raise and lower light levels.
 - c. Recall favorite light levels.
 4. Four-Button Preset Wall station:
 - a. Recall four scenes plus all on or all off for one group of fixtures.
 - b. Master raise/lower control for entire group of fixtures.
 - c. Integral IR receiver for personal control.
 - d. Immediate local LED response upon button activation to indicate that a system command has been requested.
 5. Wired Key switch:
 - a. Allows control of any devices part of the lighting control system.
 - b. Communications: Utilize RS485 wiring for low-voltage communications link.
 - c. Functionality:
 - 1) Allows for easy reprogramming without replacing unit.
 - 2) Requires key insertion to activate actions.
 - d. Engrave keypads with button, zone, and scene descriptions as indicated on the drawings.
 - e. Software Configuration:
 - 1) Customizable control station device button functionality:
 - a) Key positions can be programmed to perform single defined action.
 - b) Key positions can be programmed using conditional logic off of a state variable such as time of day or partition status.

2.6 LIGHTING CONTROL PROFILES

- A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.
- C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

- D. Specific device parameters (e.g. sensor time delay and photocell set point) shall be configurable via a lighting control profile.
- E. All lighting control profiles shall be stored on the network control gateway device, with a system backup on the software's host server.
- F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.7 MANAGEMENT SOFTWARE

- A. Every device parameter (e.g. sensor time delay and photocell set point) shall be available and configurable remotely from the software.
- B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing datecode, custom label(s), and parent network device.
- D. A printable network inventory report shall be available via the software.
- E. A printable report detailing all system profiles shall be available via the software.
- F. Software shall require all users to login with a Username and Password.
- G. Software shall provide at least three permission levels for users.
- H. All sensitive stored information and privileged communication by the software shall be encrypted.

- I. All device firmware and system software updates must be available for automatic download and installation via the internet.
- J. Software shall be capable of managing systems interconnected via a WAN (wide area network)

2.8 EMS COMPATIBILITY

- A. System shall be BACnet Testing Laboratories (BTL) listed as a BACnet Building Controller (B-BC).
- B. Native BACnet MS/TP and IP (optional).
- C. BACnet IP connection shall translate and forward lighting relay and other select control commands from BMS system to networked control devices via profiles stored in the system Gateway. All system devices shall be available for polling for devices status.

2.9 ACCESSORIES

- A. Emergency Lighting Interface:
 - 1. Provides total system listing to UL 924 when used with lighting control system.
 - 2. Senses all three phases of building power.
 - 3. Provides an output to power panels or digital ballast interfaces if power on any phase fails and sends all lights controlled by these devices to an emergency light level setting. Lights to return to their previous intensities when normal power is restored.
 - 4. Accepts a contact closure input from a fire alarm control panel.
- B. Provide power supplies as indicated or as required to power system devices and accessories.
 - 1. Product(s):
 - a. Junction box-mounted power supply for shades, keypads, and accessories, and for providing additional low voltage power to communication link; with miswire and thermal protection.
 - b. Plug-in power supply for shades, drapery drive units, keypads, and accessories, and for providing additional low voltage power to communication link; with miswire protection; powered from standard receptacle using cord 6 feet (1.8 m) in length.
 - c. Ten output power supply panel for shades, drapery drive units, keypads, and accessories, and for providing additional low voltage power to communication link.
 - d. Power supply for keypads and accessories (not for shades/window treatments), and for providing additional low voltage power to communication link.
- C. Provide locking covers for controls where indicated.
 - 1. Reversible to allow lock to be located on either side of control.

2. Compatible with IR controls.
3. Does not reduce specified IR range by more than 50 percent of its original

2.10 SOURCE QUALITY CONTROL

- A. Factory Testing:
 1. Perform full-function factory testing on all completed assemblies. Statistical sampling is not acceptable.
 2. Perform full-function factory testing on 100 percent of all ballasts and LED drivers.
 3. Perform factory audit burn-in of all dimming assemblies and panels at 104 degrees F (40 degrees C) at full load for two hours.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- B. Verify that mounting surfaces are ready to receive system components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, except for mounting heights specified in those standards.
- B. Install products in accordance with manufacturer's instructions.
- C. Define each dimmer/relay load type, assign each load to a zone, and set control functions.
- D. Sensor Locations:
 1. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", locate sensors in accordance with layout provided by Lighting Control Manufacturer. Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, locate sensors in accordance with Drawings.
 2. Sensor locations indicated are diagrammatic. Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage, in accordance with manufacturer's recommendations.

- E. Mount exterior daylight sensors to point due north with constant view of daylight.
- F. Ensure that daylight sensor placement minimizes sensor view of electric light sources. Locate ceiling-mounted and luminaire-mounted daylight sensors to avoid direct view of luminaires.
- G. Automated Shade Control Sensors:
 - 1. Mount rooftop cloudy day sensors to point in the direction of each facade.
 - 2. Ensure that window shadow sensor placement provides an unobstructed view of outdoors. Do not place at a skylight or above indirect luminaires.
- H. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.
- I. LED Light Engine/Array Lead Length: Do not exceed 100 feet (31 m).
- J. System and Network Integration Consultation: Include as part of the base bid additional costs for Lighting Control Manufacturer to conduct meeting with facility representative and other related equipment manufacturers to discuss equipment and integration procedures.
 - 1. Coordinate scheduling of visit with Lighting Control Manufacturer. Manufacturer recommends that this visit be scheduled early in construction phase, after system purchase but prior to system installation.
- K. Identify system components in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Startup Services:
 - 1. Manufacturer's authorized Service Representative to conduct minimum of two site visits to ensure proper system installation and operation.
 - 2. Conduct Pre-Installation visit to review requirements with installer as specified in Part 1 under "Administrative Requirements".
 - 3. Conduct second site visit upon completion of lighting control system to perform system startup and verify proper operation:
 - a. Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", authorized Service Representative to verify sensor locations, in accordance with layout provided by Lighting Control Manufacturer; Lighting Control Manufacturer may direct Contractor regarding sensor relocation should conditions require a deviation from locations indicated.
 - b. Verify connection of power wiring and load circuits.
 - c. Verify connection and location of controls.
 - d. Energize lighting management hubs and download system data program.
 - e. Address devices.

- f. Verify proper connection of panel links (low voltage/data) and address panel.
 - g. Verify system operation control by control.
 - h. Verify proper operation of manufacturer's interfacing equipment.
 - i. Configure initial groupings of ballast for wall controls, daylight sensors and occupancy sensors.
 - j. Provide initial rough calibration of sensors; fine-tuning of sensors is responsibility of Contractor unless provided by Lighting Control Manufacturer as part of Sensor Layout and Tuning service where specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS".
 - k. Train Owner's representative on system capabilities, operation, and maintenance, as specified in Part 3 under "Closeout Activities".
 - l. Obtain sign-off on system functions.
4. Correct defective work, adjust for proper operation, and retest until entire system complies with contract documents.

3.4 ADJUSTING

- A. On-Site Scene and Level Tuning: Include as part of the base bid additional costs for Lighting Control Manufacturer to visit site to conduct meeting with Engineer to make required lighting adjustments to the system for conformance with original design intent.
- B. Sensor Fine-Tuning: Where Lighting Control Manufacturer Sensor Layout and Tuning service is specified in Part 2 under "DIGITAL-NETWORK LIGHTING CONTROL SYSTEM - GENERAL REQUIREMENTS", Lighting Control Manufacturer to provide up to two additional post-startup on-site service visits for fine-tuning of sensor calibration. Where Lighting Control Manufacturer Sensor Layout and Tuning service is not specified, Contractor to provide fine-tuning of sensor calibration descriptions and locations of defective work.

3.5 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 COMMISSIONING

- A. See Section 019113 - General Commissioning Requirements for commissioning requirements.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration:

1. On-Site Performance-Verification Walkthrough: Include as part of the base bid additional costs for lighting control manufacturer to provide on-site demonstration of system functionality to commissioning agent.

B. Training:

1. Include services of manufacturer's authorized Service Representative to perform on-site training of Owner's personnel on operation, adjustment, and maintenance of lighting control system as part of standard system start-up services.
 - a. Include training on software to be provided:
 - 1) Configuration software used to make system programming and configuration changes.
 - 2) Control and monitor.
 - 3) Energy savings display software.
 - b. Customer-Site Solution Training Visit: Include as part of the base bid additional costs for Lighting Control Manufacturer to provide one day(s) of additional on-site system training.

3.8 PROTECTION

- A. Protect installed products from subsequent construction operations.

3.9 MAINTENANCE

- A. System Optimization Visit: Include as part of the base bid additional costs for Lighting Control System Manufacturer to visit site six months after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

3.10 START-UP & SUPPORT FEATURES

- A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.
 1. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.
 2. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.
 3. All system devices shall be capable of being given user defined names.
 4. All devices within the network shall be able to have their firmware upgraded remotely and without being physically uninstalled for the purpose of upgrading functionality at a later date.
 5. All sensor devices shall have the ability to detect improper communication wiring and blink it's LED in a specific cadence as to alert installation/startup personnel.

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END OF SECTION

SECTION 262100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260529 - Hangers and Supports for Electrical Systems.
- E. Section 260533.13 - Conduit for Electrical Systems.
- F. Section 260533.23 - Surface Raceways for Electrical Systems: Wireways.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 262300 - Low-Voltage Switchgear: Service entrance equipment.
- I. Section 262413 - Switchboards: Service entrance equipment.
- J. Section 262416 - Panelboards: Service entrance equipment.
- K. Section 262713 - Electricity Metering: Non-utility electrical metering.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
 - 1. See Section 012100 - Allowances, for allowances affecting this section.
 - 2. Include cash allowance for Utility Company charges associated with providing service.
- B. Unit Prices:
 - 1. See Section 012200 - Unit Prices, for additional unit price requirements.
 - 2. Primary:
 - a. Basis of Measurement: By the lineal foot, for each configuration.

- b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
- 3. Secondary:
 - a. Basis of Measurement: By the lineal foot, for each configuration.
 - b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
- 4. Transformer Pad/Vault:
 - a. Basis of Measurement: Per unit, for each type.
 - b. Basis of Payment: Includes purchase, delivery, and installation.

1.4 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.5 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.7 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

1.8 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).
 - 2. NFPA 70 (National Electrical Code).
 - 3. The requirements of the Utility Company.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility: As indicated on drawings.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment components in accordance with Section 260529.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 260526.
- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 260553.

3.4 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

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END OF SECTION 262100

LOW-VOLTAGE ELECTRICAL SERVICE
ENTRANCE

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General purpose transformers.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 262416 - Panelboards.
- G. Section 262713 - Electricity Metering: Instrument transformers for electrical metering.

1.3 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers; 1982 (R2006).
- C. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2009.
- F. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
 - 1. Vibration Isolators: Include attachment method and rated load and deflection.
- C. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
- D. Manufacturer's equipment seismic qualification certification.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.
- F. Field Quality Control Test Reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- H. Maintenance Data: Include recommended maintenance procedures and intervals.
- I. Project Record Documents: Record actual locations of transformers.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 - 1. Greater than 10 kVA: 104 degrees F maximum.
 - 2. Less than 10 kVA: 77 degrees F maximum.
- B. Ambient Temperature: Do not exceed 86 degrees F average or 104 degrees F maximum measured during any 24 hour period during and after installation of transformers.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.

- B. Eaton Corporation www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. Substitutions: See Section 016000 - Product Requirements.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F.
 - b. Less than 10 kVA: Not exceeding 77 degrees F.
 - 3. Ambient Temperature: Not exceeding 86 degrees F average or 104 degrees F maximum measured during any 24 hour period.
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.
- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.
- E. Provide seismic restraints.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 260533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 260529, where not furnished by transformer manufacturer.
 - 2. Use integral transformer flanges to support wall-mounted transformers.
 - 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
 - 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 260526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.
 - 1. 167 kVA single phase, 500 kVA three phase and smaller:
 - a. Perform turns ratio tests at all tap positions.
 - 2. Larger than 167 kVA single phase and 500 kVA three phase:
 - a. Verify that control and alarm settings on temperature indicators are as specified.
 - b. Perform excitation-current tests on each phase.
 - c. Measure the resistance of each winding at each tap connection.
 - d. Perform an applied voltage test on all high- and low-voltage windings-to-ground.

3.4 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262200

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SECTION 262300 - LOW-VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) arc-resistant metal-enclosed drawout switchgear and accessories for service and distribution applications.
- B. Low-voltage power circuit breakers for switchgear.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 262100 - Low-Voltage Electrical Service Entrance.
 - 1. Includes Utility Company contact information.
- H. Section 262413 - Switchboards.
- I. Section 262419 - Motor-Control Centers.
- J. Section 262513 - Low-Voltage Busways.
- K. Section 262713 - Electricity Metering: For interface with equipment specified in this section.
- L. Section 262813 - Fuses: Fuses for fusible switches.
 - 1. Includes requirements for spare fuses and spare fuse cabinets.
- M. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. ANSI C37.50 - American National Standard for Switchgear - Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures; 2012.
- B. ANSI C37.51 - American National Standard for Switchgear - Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies - Conformance Test Procedures; 2003 (R2010), with Amendment 1, 2010.
- C. IEEE C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures; 2015.
- D. IEEE C37.16 - IEEE Standard for Preferred Ratings, Related Requirements, and Application Recommendations for Low-Voltage AC (635 V and below) and DC (3200 V and below) Power Circuit Breakers; 2009.
- E. IEEE C37.17 - IEEE Standard for Trip Systems for Low-Voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers; 2012.
- F. IEEE C37.20.1 - IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear; 2002 (R2007).
- G. IEEE C37.20.7 - IEEE Guide for Testing Metal-Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults; 2007 (Corrigendum 2010).
- H. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- J. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- K. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- O. UL 1066 - Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures; Current Edition, Including All Revisions.
- P. UL 1558 - Switchgear; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify Architect of any conflicts with or deviations Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchgear:

1. Coordinate with Utility Company to provide switchgear with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. See Section 262100 for Utility Company contact information and additional requirements.
4. Obtain Utility Company approval of switchgear prior to fabrication.
5. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.
6. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchgear, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, short-time current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include dimensioned plan and elevation views of switchgear and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Include documentation demonstrating selective coordination upon request.
 4. Include key-type mechanical interlock scheme with sequence of operations, as applicable.
 5. Include proposed mimic bus single-line diagram arrangement.
 6. Arc-Resistant Switchgear: Include proposed plenum arrangement, where applicable.
 7. Identify mounting conditions required for equipment seismic qualification.

- D. Manufacturer's equipment seismic qualification certification.
- E. Service Entrance Switchgear: Include documentation of Utility Company approval of switchgear.
- F. Source Quality Control Test Reports: Include reports for tests designated in IEEE C37.20.1 as production tests.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Field Quality Control Test Reports.
- I. Project Record Documents: Record actual installed locations of switchgear and final equipment settings.
- J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two of each different key.
 - 3. Circuit Breakers:
 - a. Handles Necessary for Racking of Devices: One for each electrical room containing drawout switchgear.
 - b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout switchgear.
 - c. Removable Covers: One for blocking each different opening size when circuit breaker is temporarily removed from its compartment.
 - 4. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchgear in accordance with manufacturer's instructions and IEEE C37.20.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchgear, which is not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchgear internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Low-Voltage Switchgear - Basis of Design.
- B. Low-Voltage Switchgear - Other Acceptable Manufacturers:
 - 1. ABB/GE: www.geindustrial.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 4. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- C. Substitutions: See Section 016000 - Product Requirements.

2.2 LOW-VOLTAGE SWITCHGEAR

- A. Provide switchgear assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front standard (non-arc-resistant) type metal-enclosed drawout switchgear complying with IEEE C37.20.1 and ANSI C37.51; listed and labeled as complying with UL 1558; ratings, configurations and features as indicated on the drawings.
- D. Configuration:

1. Compartmentalization: Provide barriered compartments for each overcurrent protective device, distribution bus, and rear cable connection area.
 2. Arrangement: Rear accessible, front and rear aligned.
 3. Rear Access: Bolted covers.
- E. Arc-Resistance Rating:
1. Passes criteria for arc-resistant functionality when tested in accordance with applicable requirements of IEEE C37.20.7 for Type 2 accessibility.
 2. Arc exhaust gases must be discharged through a plenum into designated area approved by Architect.
 3. Arc resistant rating valid through maximum current of not less than the available fault current at the installed location.
- F. Service Entrance Switchgear:
1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 3. Comply with Utility Company requirements for electrical service.
 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
 5. See Section 262100 for additional requirements.
- G. Switchgear With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 262513.
- H. Switchgear With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).
- I. Provide integral top rail-mounted lifting device where indicated.
- J. Seismic Qualification: Provide switchgear and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.
- K. Service Conditions:
1. Provide switchgear and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature: Between -22 degrees F and 104 degrees F.
 2. Provide switchgear and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- L. Short Circuit Current Rating:

1. Provide switchgear with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- M. Short-Time Current (30-Cycle Withstand) Rating: Equivalent to specified short circuit current rating.
- N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- O. Bussing: Sized in accordance with UL 1558 temperature rise requirements.
 1. Main bus (horizontal cross bus) to be fully rated through full length of switchgear.
 2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 3. Provide solidly bonded equipment ground bus through full length of switchgear, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Phase and Neutral Bus Material: Copper.
 5. Ground Bus Material: Copper.
- P. Conductor Terminations: Suitable for use with the conductors to be installed.
 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
- Q. Enclosures:
 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Finish: Manufacturer's standard unless otherwise indicated.
 3. Enclosure Space Heaters:
 - a. Provide in each switchgear section installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in switchgear or suitable external branch circuit as indicated or as required.
 4. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type unless otherwise indicated.

- b. Color: Manufacturer's standard.
- c. Access Doors: Lockable, with all locks keyed alike.
- d. Walk-in Enclosure Features:
 - 1) Personnel Doors: Open to exterior; equipped with panic hardware.
 - 2) Aisle lighting, with switch at each access door.
 - 3) GFCI duplex convenience receptacle.
- R. Future Provisions:
 - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
 - 2. Arrange and equip through bus and ground bus to accommodate future installation of additional switchgear sections.
- S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list switchgear as a complete assembly including surge protective device.
- T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Provide separate neutral current sensor where applicable.
- U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- V. Owner Metering: Comply with Section 262713.
- W. Owner Metering:
 - 1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified.
 - 2. Measured Parameters:
 - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase and neutral.
 - c. Frequency (Hz).
 - d. Real power (kW): For each phase, 3-phase total.
 - e. Reactive power (kVAR): For each phase, 3-phase total.
 - f. Apparent power (kVA): For each phase, 3-phase total.
 - g. Power factor.
 - h. Real energy (kWh).
 - i. Reactive energy (kVARh).
 - j. Apparent energy (kVAh).
 - k. Current demand.
 - l. Power demand: Real, reactive, and apparent.
 - 3. Meter Accuracy: Plus/minus 1.0 percent.

4. Features:
 - a. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.
 - b. KYZ pulse output.
 - c. Adjustable demand interval.
 - d. Remote monitoring capability via PC.

X. Instrument Transformers:

1. Comply with IEEE C57.13.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Connect secondaries to shorting terminal blocks.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 LOW-VOLTAGE POWER CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, trip-free low-voltage power circuit breakers with two-step stored energy closing mechanism; 100 percent rated; complying with IEEE C37.13, IEEE C37.16, IEEE C37.17, and ANSI C37.50; listed and labeled as complying with UL 1066; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity: Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
- C. Operation:
 1. Provide manually operated circuit breakers unless otherwise indicated.
 2. Provide electrically operated circuit breakers where indicated.
 3. Pad-Lock Provision: For preventing circuit breaker closing operation.
- D. Construction: Drawout.
 1. Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
 2. Provide safety interlock to prevent racking of circuit breaker while in the ON position.
 3. Pad-Lock Provision: For preventing circuit breaker drawout operation.
- E. Fused Circuit Breakers:
 1. Fuses: Class L, selected for coordination with circuit breaker trip units.
 2. Blown Fuse Protection: Provide blown fuse protection to trip circuit breaker in the event of the opening, or absence, of a fuse and to prevent closing of circuit breaker until reset operation is performed; provide blown fuse status indication.
 3. Where fuse is not integral with circuit breaker and mounted in a separate compartment, provide interlock to prevent fuse access with the circuit breaker in the ON position.
- F. Trip Units: Solid state, microprocessor-based, true rms sensing.
 1. Provide the following field-adjustable trip response settings:
 - a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.

- b. Long time delay.
- c. Short time pickup and delay.
- d. Instantaneous pickup.
 - 1) Include instantaneous function for feeder circuit breakers.
 - 2) Omit instantaneous function or provide ability to turn instantaneous function off for main and tie circuit breakers.
- e. Ground fault pickup and delay where ground fault protection is indicated.
- 2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- 3. Provide communication capability where indicated: Compatible with system indicated.
- G. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
 - 5. Truck-Operated Cell Switch: For indicating circuit breaker racking position.

2.4 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test switchgear according to IEEE C37.20.1, including the following production tests on each switchgear assembly or component:
 - 1. Dielectric tests.
 - 2. Mechanical operation tests.
 - 3. Grounding of instrument transformer cases test.
 - 4. Electrical operation and control wiring tests, including polarity and sequence tests.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchgear and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchgear.

- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchgear in accordance with NECA 1 (general workmanship) and IEEE C37.20.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for drawout circuit breakers.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install switchgear plumb and level.
- F. Unless otherwise indicated, mount switchgear on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Install all field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable circuit breaker tripping function settings as indicated.
- K. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- L. Identify switchgear in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Before energizing switchgear, perform preoperation checks in accordance with IEEE C37.20.1.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.1.

- G. Low-Voltage Power Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.2 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
 - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 2. Test functions of the trip unit by means of secondary injection.
- H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- I. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- J. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- K. Test shunt trips to verify proper operation.
- L. Correct deficiencies and replace damaged or defective switchgear assemblies or associated components.
- M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchgear covers and doors.

3.5 CLEANING

- A. Clean dirt and debris from switchgear enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchgear and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's authorized representative.
4. Location: At project site.

3.7 PROTECTION

- A. Protect installed switchgear assemblies from subsequent construction operations.

END OF SECTION 262300

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SECTION 262413 - SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 262100 - Low-Voltage Electrical Service Entrance.
 - 1. Includes Utility Company contact information.
- H. Section 262300 - Low-Voltage Switchgear.
- I. Section 262513 - Low-Voltage Busways.
- J. Section 262813 - Fuses: Fuses for fusible switches.
 - 1. Includes requirements for spare fuses and spare fuse cabinets.
- K. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.

- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- G. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- H. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 891 - Switchboards; Current Edition, Including All Revisions.
- O. UL 977 - Fused Power-Circuit Devices; Current Edition, Including All Revisions.
- P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the electrical outage time with the school district for crossover of power when the new switchboard is installed. Do not disconnect power from the school without written authorization. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
6. Notify Architect of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:

1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.
2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.
3. Obtain Utility Company approval of switchboard prior to fabrication.
4. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.
 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.
- F. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as production (routine) tests.

- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Field Quality Control Test Reports.
- I. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.
- J. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two of each different key.
 - 3. Electronic Trip Circuit Breakers: Provide one portable test set.
 - 4. Drawout Devices:
 - a. Handles Necessary for Racking of Devices: One for each electrical room containing switchgear with drawout devices.
 - b. Lifting Yokes: One of each different yoke required, for each electrical room containing drawout devices.
 - c. Portable Lifting Devices: One for each electrical room containing switchboards with drawout devices and no integral top rail-mounted lifting device.
 - d. Removable Covers: One for blocking each different opening size when device is temporarily removed from its compartment.
 - 5. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Switchboards:
 - 1. ABB/GE; _____: www.geindustrial.com/#sle.
 - 2. Eaton Corporation; _____: www.eaton.com/#sle.
 - 3. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - 4.
- B. Substitutions: See Section 016000 - Product Requirements.
- C. Products by Siemens Industry are not permitted.
- D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 SWITCHBOARDS

- A. Switchboard shall be provided with weatherproof enclosure suitable for outdoor location as required.
- B. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- E. Front-Connected Switchboards:
 - 1. Main Device(s): Individually-mounted.
 - 2. Feeder Devices: Panel/group-mounted.
 - 3. Arrangement: Front accessible only (not rear accessible), rear aligned.
 - 4. Gutter Access: Bolted covers.
- F. Service Entrance Switchboards:
 - 1. Listed and labeled as suitable for use as service equipment according to UL 869A.
 - 2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.
 - 3. Comply with Utility Company requirements for electrical service.
 - 4. Utility Metering Provisions: Provide separate barriered compartment complying with Utility Company requirements where indicated or where required by Utility Company. Include hinged sealable door and provisions for Utility Company current transformers (CTs), potential transformers (PTs), or potential taps as required.
 - 5. See Section 262100 for additional requirements.
- G. Switchboards With Busway Transitions: Configured for bussed connection to busway provided in accordance with Section 262513.
- H. Switchboards With Fire Pump Taps: Provide separate bussed vertical section with suitable lugs for fire pump connection to line side of main service disconnect device(s).
- I. Switchboards With Drawout Devices: Provide integral top rail-mounted lifting device where indicated.
- J. Seismic Qualification: Provide switchboards and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.
- K. Service Conditions:
 - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude: Less than 6,600 feet.
 - b. Ambient Temperature:
 - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers:
Between 23 degrees F and 104 degrees F.

- 2) Switchboards Containing Fusible Switches: Between -22 degrees F and 104 degrees F.
2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- L. Short Circuit Current Rating:
 1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
 3. Minimum Rating: 65,000 rms symmetrical amperes.
 4. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 5. Label equipment utilizing series ratings as required by NFPA 70.
- M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- N. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- O. Bussing: Sized in accordance with UL 891 temperature rise requirements.
 1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
 2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Phase and Neutral Bus Material: Aluminum.
 5. Ground Bus Material: Aluminum.
- P. Conductor Terminations: Suitable for use with the conductors to be installed.
 1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs unless otherwise indicated.
 - 2) Provide compression lugs where indicated.

Q. Enclosures:

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1 or Type 2 (drip-proof).
 - b. Outdoor Locations: Type 3R.
2. Finish: Manufacturer's standard unless otherwise indicated.
3. Enclosure Space Heaters:
 - a. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation.
 - b. Heater Control: Thermostat.
 - c. Heater Power Source: Provide connection to transformer factory-installed in switchboard or suitable external branch circuit as indicated or as required.
4. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type unless otherwise indicated.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.
 - d. Walk-in Enclosure Features:
 - 1) Personnel Doors: Open to exterior; equipped with panic hardware.
 - 2) Aisle lighting, with switch at each access door.
 - 3) GFCI duplex convenience receptacle.

R. Future Provisions:

1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.

S. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list switchboards as a complete assembly including surge protective device.

T. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence or residual ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.

- c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- U. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.
- V. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 OVERCURRENT PROTECTIVE DEVICES

- A. Fusible Devices:
 - 1. Fusible Switches:
 - a. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
 - b. Fuse Clips: As required to accept indicated fuses.
 - 1) Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
 - c. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
 - 2. Fused Power-Circuit Devices:
 - a. Description: Quick-make, quick-break, dead-front bolted-pressure contact switches and high-pressure butt contact switches listed and labeled as complying with UL 977; ratings, configurations, and features as indicated on the drawings.
 - b. Bolted-Pressure Contact Switches: Devices with additional pressure or clamping action provided at both ends of switch blades when blades are in the fully closed position.
 - c. High-Pressure Butt Contact Switches: Devices with butt-type contacts and spring-charged mechanism.
 - d. Minimum Short Circuit Current Rating: 200,000 rms symmetrical amperes when protected by Class L fuses.
 - e. Fuse Clips: As required to accept Class L fuses.

- f. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- g. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating switch position.
 - 3) Blown fuse protection and indication.

B. Circuit Breakers:

1. Interrupting Capacity:

- a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
- b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:

- a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 2) Provide electronic trip circuit breakers where indicated.
- b. Minimum Interrupting Capacity:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
- c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 2) Provide interchangeable trip units where indicated.
- d. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

- 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
- 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- 3) Provide communication capability where indicated: Compatible with system indicated.
- e. Provide the following circuit breaker types where indicated:
 - 1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.
 - 2) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- f. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - 3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.
3. Insulated Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.

- b. Operation:
 - 1) Provide manually operated circuit breakers unless otherwise indicated.
 - 2) Provide electrically operated circuit breakers where indicated.
 - 3) Pad-Lock Provision: For preventing circuit breaker closing operation.
- c. Construction:
 - 1) Provide fixed-mount circuit breakers unless otherwise indicated.
 - 2) Provide drawout circuit breakers where indicated.
- d. Drawout Circuit Breakers:
 - 1) Allows withdrawal of circuit breaker into test and disconnected positions, with racking position indication (connected, test, disconnected, withdrawn).
 - 2) Provide safety interlock to prevent racking of circuit breaker while in the ON position.
 - 3) Pad-Lock Provision: For preventing circuit breaker drawout operation.
- e. Minimum Interrupting Capacity:
 - 1) 42,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 65,000 rms symmetrical amperes at 480 VAC.
- f. Trip Units: Solid state, microprocessor-based, true rms sensing.
 - 1) Provide the following field-adjustable trip response settings:
 - (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - (b) Long time delay.
 - (c) Short time pickup and delay.
 - (d) Instantaneous pickup.
 - (e) Ground fault pickup and delay where ground fault protection is indicated.
 - 2) Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - 3) Provide communication capability where indicated: Compatible with system indicated.
- g. Provide the following circuit breaker types where indicated:
 - 1) Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.

- h. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - 2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - 3) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - 4) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.4 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:
 - 1. Dielectric tests.
 - 2. Mechanical operation tests.
 - 3. Grounding of instrument transformer cases test.
 - 4. Electrical operation and control wiring tests, including polarity and sequence tests.
 - 5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- G. Install switchboards plumb and level.
- H. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with Section 033000.
- I. Provide grounding and bonding in accordance with Section 260526.
- J. Install all field-installed devices, components, and accessories.
- K. Provide fuses complying with Section 262813 for fusible switches as indicated.
- L. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- M. Set field-adjustable circuit breaker tripping function settings as indicated.
- N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- O. Provide filler plates to cover unused spaces in switchboards.
- P. Identify switchboards in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.
- E. Inspect and test in accordance with NETA ATS, except Section 4.

- F. Perform inspections and tests listed in NETA ATS, Section 7.1.
- G. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- H. Molded Case and Insulated Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- I. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- J. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- K. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- L. Test shunt trips to verify proper operation.
- M. Correct deficiencies and replace damaged or defective switchboards or associated components.
- N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.5 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- C. Repair scratched or marred surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.

- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.7 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- G. Section 262200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- H. Section 262813 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- I. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.
- F. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- G. NEMA PB 1 - Panelboards; 2011.
- H. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000 Volts or Less; 2023.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- L. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- M. UL 67 - Panelboards; Current Edition, Including All Revisions.
- N. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- O. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- P. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- Q. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- R. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- S. UL 1699 - Arc-Fault Circuit-Interruption; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 4. Include documentation of listed series ratings upon request.
 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- F. Field Quality Control Test Reports.
- G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- I. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.

2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Substitutions: See Section 016000 - Product Requirements.
- E. Products by Siemens Industry are not permitted

- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- H. Bussing: Sized in accordance with UL 67 temperature rise requirements.
1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide 200 percent rated neutral bus and lugs where indicated, where oversized neutral conductors are provided, or where panelboards are fed from K-rated transformers.
 3. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 4. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

- a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide removable end walls for NEMA Type 1 enclosures.
 - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 264300, list and label panelboards as a complete assembly including surge protective device.
- M. Panelboard Contactors: Where panelboard contactors are indicated, provide electrically operated, mechanically held magnetic contactor complying with NEMA ICS 2.
1. Ampere Rating: Not less than ampere rating of panelboard bus.
 2. Short Circuit Current Rating: Not less than the panelboard short circuit current rating.
 3. Coil Voltage: As required for connection to control system indicated.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- P. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

- Q. Provide the following features and accessories where indicated or where required to complete installation:
1. Feed-through lugs.
 2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase and Neutral Bus Material: Aluminum.
 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
1. Provide bolt-on type or plug-in type secured with locking mechanical restraints.
 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
1. Provide surface-mounted enclosures unless otherwise indicated.
 2. Fronts: Provide trims to cover access to load terminals, wiring gutters, and other live parts, with exposed access to overcurrent protective device handles.
 3. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 4. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 5. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
2. Phase and Neutral Bus Material: Aluminum.
3. Ground Bus Material: Aluminum.

D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.

E. Enclosures:

1. Provide surface-mounted or flush-mounted enclosures as indicated.
2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Fusible Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in the OFF position. Provide means for locking switch cover in the closed position. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
4. Conductor Terminations:
 - a. Provide compression lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

B. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. Provide compression lugs unless otherwise indicated.

- b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- 4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - b. Provide interchangeable trip units where indicated.
- 5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
 - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 - c. Provide communication capability where indicated: Compatible with system indicated.
- 6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- 7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
 - c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.
 - d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
 - e. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- 8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- 9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
- 10. Do not use tandem circuit breakers.
- 11. Do not use handle ties in lieu of multi-pole circuit breakers.

12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
13. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
 - c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 - d. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 - e. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.6 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Install panelboards plumb.

- G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- I. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- J. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- K. Provide grounding and bonding in accordance with Section 260526.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 - 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- L. Install all field-installed branch devices, components, and accessories.
- M. Provide fuses complying with Section 262813 for fusible switches as indicated.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- P. Set field-adjustable circuit breaker tripping function settings as indicated.
- Q. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 260573.
- R. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- S. Provide filler plates to cover unused spaces in panelboards.
- T. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Fire detection and alarm circuits.
 - 3. Communications equipment circuits.
 - 4. Intrusion detection and access control system circuits.
 - 5. Video surveillance system circuits.
- U. Identify panelboards in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
 - 1. Perform insulation-resistance tests on all control wiring with respect to ground.
 - 2. Test functions of the trip unit by means of secondary injection.
- E. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- F. Test GFCI circuit breakers to verify proper operation.
- G. Test AFCI circuit breakers to verify proper operation.
- H. Test shunt trips to verify proper operation.
- I. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.
- J. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

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END OF SECTION 262416

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SECTION 262713 - ELECTRICITY METERING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment for Owner electricity metering:
 - 1. Single circuit electricity meters.
 - 2. Multi-circuit electricity meters.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262100 - Low-Voltage Electrical Service Entrance: Requirements for Utility Company electricity metering.
- F. Section 262300 - Low-Voltage Switchgear: For interface with meters specified in this section.
- G. Section 262413 - Switchboards: For interface with meters specified in this section.
- H. Section 262416 - Panelboards: For interface with meters specified in this section.
- I. Section 262419 - Motor-Control Centers: For interface with meters specified in this section.
- J. Section 262813 - Fuses.
 - 1. Includes requirements for spare fuses and spare fuse cabinets.

1.3 REFERENCE STANDARDS

- A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2022.
- B. ANSI C12.20 - American National Standard for Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes; 2018, with Errata.
- C. IEC 62053-21 - Electricity Metering Equipment (A.C.) - Particular Requirements - Part 21: Static Meters for Active Energy (Classes 1 and 2); 2016 (Corrigendum 2018).

- D. IEC 62053-22 - Electricity Metering Equipment (A.C.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S); 2016 (Corrigendum 2018).
- E. IEC 62053-23 - Electricity Metering Equipment (A.C.) - Particular Requirements - Part 23: Static Meters for Reactive Energy (Classes 2 and 3); 2016 (Corrigendum 2018).
- F. IEEE 1459 - Standard Definitions for the Measurement of Electrical Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions; 2010.
- G. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
 - 2. Coordinate the work with other installers to provide communication lines required for electricity metering system interface.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Conduct meeting with facility representative and other related equipment manufacturers to discuss electricity metering system interface requirements.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.
- C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of meters and final equipment settings.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two of each different key.
 - 3. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Electricity Meters - Basis of Design: Veris Industries as indicated under product description below;
- B. Electricity Meters - Other Acceptable Manufacturers:
 - 1. Veris Industries; E5x Series Enhanced Power and Energy Meter:
 - 2. Same as manufacturer of electrical distribution equipment used for this project.
 - a. ABB/GE: www.geindustrial.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
 - d. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- C. Substitutions: See Section 016000 - Product Requirements.
- D. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.
- E. Source Limitations: Furnish electricity meters produced by a single manufacturer and obtained from a single supplier.

2.2 EQUIPMENT FOR OWNER ELECTRICITY METERING

- A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.
- D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.
- E. Enclosures:
 - 1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 260533.16.
 - 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R or Type 4.
 - 3. Provide lockable door(s) for outdoor locations.
 - 4. Finish: Manufacturer's standard unless otherwise indicated.
- F. Instrument Transformers:

1. Comply with IEEE C57.13, where applicable.
2. Select suitable ratio, burden, and accuracy as required for connected devices.
3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

G. Interface with Other Work:

1. Interface with electrical power monitoring system.
2. Interface with building automation system.

2.3 SINGLE CIRCUIT ELECTRICITY METERS

A. Single Circuit Electricity Meter - Basis of Design: Veris Industries; E5x Series Enhanced Power and Energy Meter with LCD screen interface; 5-year warranty; utilizes voltage mode CTs that do not require terminal shorting blocks; compatible with solid-core, split-core, and rope CTs.

1. Accuracy:
 - a. Real/Active Power/Energy: Revenue grade; plus/minus 0.2 percent, complying with ANSI C12.20 accuracy and IEC 62053-22, Class 0.2S.
 - b. Reactive Power/Energy: Plus/minus 2.0 percent, complying with IEC 62053-23, Class 2.
2. Measured Parameters:
 - a. Real/active energy (kWh); per phase and total of all phases.
 - b. Reactive energy (kVARh) and apparent energy (kVAh); total of all phases.
 - c. Net present demand over a user-specified interval (block or sliding window); real/active power (kW), reactive power (kVAR), and apparent power (kVA).
 - d. Maximum (peak) demand intervals; real/active power (kW), reactive power (kVAR), and apparent power (kVA).
 - e. Real/active power (kW), reactive power (kVAR), and apparent power (kVA); per phase and total of all phases.
 - f. Models Available with Bi-directional Energy Measurements:
 - 1) Real/active energy (kWh) and apparent energy (kVAh); imported (from the grid), exported (to the grid), and signed net total.
 - 2) Reactive energy (kVARh); imported (from the grid) and exported (to the grid), per quadrant as defined by IEEE 1459.
 - 3) Maximum demand; real/active power (kW), reactive power (kVAR), and apparent power (kVA); imported (from the grid) and exported (to the grid).
 - g. Current; per phase and average of all phases.
 - h. Voltage; line-to-line and line-to-neutral; per phase and average of all phases.
 - i. Power factor; per phase and average of all phases.
 - j. Frequency.

3. Models Available with Data Logging: Logs and retains in non-volatile memory up to 5760 measurement records at time intervals determined by Demand Interval duration setting (up to 60 days of readings at 15 minute intervals).
4. Alarm capability, with configurable setpoints.
 - a. Low power factor.
 - b. Current over range.
 - c. Voltage over range.
 - d. Frequency out of range.
 - e. Models available with pulse output overrun.
5. Models Available with Pulse Contact Accumulator Input(s): Up to two; user-configurable to support measurement of other related energy values (gas, water, steam, etc.) using pulse-output transducers.
6. Outputs:
 - a. Models Available with Phase Loss Alarm Output: One; user-configurable phase loss threshold.
 - b. Models Available with Pulse Output(s): Up to two.
7. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
 - a. Models available with Serial Communications:
 - 1) RS-485, 2-wire; support for Modbus RTU protocol.
 - 2) RS-485, 2-wire; support for BACnet MS/TP protocol.
 - 3) LON FT, 2-wire; support for LonTalk protocol.

2.4 MULTI-CIRCUIT ELECTRICITY METERS

- A. Multi-Circuit Electricity Meter - Basis of Design: Veris Industries; E3x Series Panelboard Monitoring System; 5-year warranty; utilizes voltage mode CTs that do not require shorting terminal blocks.
 1. Metering Capacity: As indicated or as required for circuits to be monitored (configurations available for monitoring up to 84 branch circuits, two 3-phase main devices, and two neutrals with one meter).
 2. Accuracy:
 - a. Real/Active Power/Energy (for models that measure this parameter): Revenue grade; plus/minus 1.0 percent (including branch CTs); complying with ANSI C12.1 and IEC 62053-21, Class 1.
 - b. Voltage (for models that measure this parameter): Plus/minus 0.5 percent.
 - c. Current: Plus/minus 0.5 percent.
 3. Measured Parameters at Main Device:
 - a. Current; per phase and average of all phases.
 - b. Maximum current; per phase and maximum average of all phases.
 - c. Current demand; per phase and average of all phases.
 - d. Maximum current demand; per phase and maximum average of all phases.
 - e. Models available with measurements for:

- 1) Current phase angle.
 - 2) Real/active energy (kWh); per phase and total of all phases.
 - 3) Snapshot of total energy as of the completion of the most recent demand interval; per phase and total of all phases.
 - 4) Real/active power (kW); per phase and total of all phases; available signed to indicate whether energy is being imported or exported.
 - 5) Apparent power (kVA); per phase and total of all phases.
 - 6) Power factor; per phase and total, based on three-phase breaker rotation, signed, to indicate leading or lagging current.
 - 7) Voltage, line-to-line and line-to neutral; per phase and average of all phases.
 - 8) Voltage phase angle.
 - 9) Frequency; phase A.
4. Measured Parameters at Branch Circuits:
- a. Current; per branch and average of all phases for multi-phase logical circuits.
 - b. Maximum current; per branch and maximum average of all phases for multi-phase logical circuits.
 - c. Current demand; per branch and average of all phases for multi-phase logical circuits.
 - d. Maximum current demand; per branch and maximum average of all phases for multi-phase logical circuits.
 - e. Models available with measurements for:
 - 1) Current phase angle.
 - 2) Real/active power (kW); per branch and total of all phases for multi-phase logical circuits; available signed to indicate whether energy is being imported or exported.
 - 3) Real/active power (kW) demand; per branch and total of all phases for multi-phase logical circuits.
 - 4) Real/active power (kW) demand maximum; per branch and total of all phases for multi-phase logical circuits.
 - 5) Real/active energy (kWh); per branch and total of all phases for multi-phase logical circuits.
 - 6) Snapshot of total energy as of the completion of the most recent demand interval; per branch and total of all phases for multi-phase logical circuits.
 - 7) Apparent power (kVA); per branch and total of all phases for multi-phase logical circuits.

- 8) Power factor; per branch and average of all phases for multi-phase logical circuits, signed to indicate leading or lagging current.
5. Alarm capability, with configurable setpoints.
 - a. Current over/under range.
 - b. Models available with voltage over/under range.
6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
 - a. Models Available with Serial Communications:
 - 1) RS-485, 2-wire or 4-wire; support for Modbus RTU protocol.
 - 2) RS-485, 2-wire; support for Modbus RTU and BACnet MS/TP protocols.
 - b. Models Available with Ethernet Communications:
 - 1) Without RJ-45 10/100 Mbit; requires Modbus TCP Gateway; support for Modbus TCP protocol.
 - 2) With RJ-45 10/100 Mbit; support for Modbus TCP, BACnet IP, and SNMP protocols.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive meters.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment components in accordance with Section 260529.
- D. Provide grounding and bonding in accordance with Section 260526.
- E. Provide fuses complying with Section 262813 as required.
- F. Identify meters and associated wiring in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.
- D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective metering system components.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

- A. Program system parameters according to requirements of Owner.

3.5 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.7 PROTECTION

- A. Protect installed system components from subsequent construction operations.

END OF SECTION 262713

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SECTION 262726 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Fan speed controllers.
- D. Receptacles.
- E. Wall plates.
- F. Floor box service fittings.
- G. Poke-through assemblies.
- H. Access floor boxes.

1.2 RELATED REQUIREMENTS

- A. Section 096900 - Access Flooring.
- B. Section 260519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- C. Section 260526 - Grounding and Bonding for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- F. Section 260539 - Underfloor Raceways for Electrical Systems.
- G. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 260583 - Wiring Connections: Cords and plugs for equipment.
- I. Section 260923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- J. Section 271000 - Structured Cabling: Voice and data jacks.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- M. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 6. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

- B. Sequencing:
 - 1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
 - 2. Surge Protection Receptacles: Include surge current rating, voltage protection rating (VPR) for each protection mode, and diagnostics information.
- C. Samples: One for each type and color of device and wall plate specified.
- D. Certificates for Surge Protection Receptacles: Manufacturer's documentation of listing for compliance with UL 1449.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data:
 - 1. Wall Dimmers: Include information on operation and setting of presets.
 - 2. GFCI Receptacles: Include information on status indicators.
 - 3. Surge Protection Receptacles: Include information on status indicators.
- H. Project Record Documents: Record actual installed locations of wiring devices.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 - 3. Extra Keys for Locking Switches: Two of each type.
 - 4. Extra Surge Protection Receptacles: Two of each type.
 - 5. Extra Wall Plates: One of each style, size, and finish.
 - 6. Extra Flush Floor Service Fittings: Two of each type.
 - 7. Extra Poke-Through Core Hole Closure Plugs: Two for each core size.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed in dwelling units.
- E. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- F. Provide GFCI protection for receptacles installed in kitchens.
- G. Provide GFCI protection for receptacles serving electric drinking fountains.
- H. Provide isolated ground receptacles for receptacles serving computers and electronic cash registers.
- I. Unless noted otherwise, do not use combination switch/receptacle devices.
- J. For flush floor service fittings, use tile rings for installations in tile floors.
- K. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.2 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- E. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
- F. Wiring Devices Installed ____: White with white nylon wall plate.
- G. Isolated Ground Convenience Receptacles: Orange.
- H. Surge Protection Receptacles: Blue.
- I. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
- J. Above-Floor Service Fittings: Gray wiring devices with satin aluminum housing.
- K. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.
- L. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.
- M. Access Floor Boxes: Gray wiring devices with gray steel cover with insert to match floor covering.

2.3 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

- D. Lighted Wall Switches: Industrial specification grade, 20 A, 120/277 V with illuminated standard toggle type switch actuator and maintained contacts; illuminated with load off; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- E. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- F. Locking Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.
- G. Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with toggle type three position switch actuator and momentary contacts; single pole double throw, off with switch actuator in center position.
- H. Locking Momentary Contact Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed three position switch actuator and momentary contacts; switches keyed alike; single pole double throw, off with switch actuator in center position.

2.4 WALL DIMMERS

- A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
- B. Control: Slide control type with separate on/off switch.

2.5 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
 - 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.
 - 6. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
 - 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
 - 3. Isolated Ground Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, with ground contacts isolated from mounting strap; isolated ground triangle mark on device face; single or duplex as indicated on the drawings.
 - 4. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 - 5. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
 - 6. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 - 7. Illuminated Convenience Receptacles: Hospital grade, 20A, 125V, NEMA 5-20R; illuminated face or indicator light to indicate power is being supplied to receptacle; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
 - 1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.6 WALL PLATES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
 4. Provide screwless wallplates with concealed mounting hardware where indicated.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- E. Brass Wall Plates: Brushed satin finish, factory-coated to inhibit oxidation.
- F. Aluminum Wall Plates: Smooth satin finish, clear anodized, factory-coated to inhibit oxidation.
- G. Chrome Wall Plates: Smooth finish, chrome plated steel.
- H. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.
- I. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.
- J. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.

- K. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.7 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Thomas & Betts Corporation: www.tnb.com/#sle.
 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Service fittings compatible with floor boxes provided under Section 260533.16 with components, adapters, and trims required for complete installation.
- C. Above-Floor Service Fittings:
1. Single Service Pedestal Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle.
 2. Single Service Pedestal Communications Outlets:
 - a. Configuration: One 1 inch bushed opening.
 - b. Voice and Data Jacks: As specified in Section 271000.
 3. Single Service Pedestal Furniture Feed:
 - a. Configuration: One 3/4 inch knockout.
 4. Dual Service Pedestal Combination Outlets:
 - a. Configuration:
 - 1) Power: One standard convenience duplex receptacle.
 - 2) Communications: One 1 inch bushed opening.
 - 3) Voice and Data Jacks: As specified in Section 271000.
 - b. Provide barrier to separate line and low voltage compartments.
- D. Flush Floor Service Fittings:
1. Single Service Flush Convenience Receptacles:
 - a. Cover: Rectangular.
 - b. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 2. Single Service Flush Communications Outlets:
 - a. Cover: Rectangular.
 - b. Configuration: _____.
 - c. Voice and Data Jacks: As specified in Section 271000.
 3. Single Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
 4. Dual Service Flush Combination Outlets:

- a. Cover: Rectangular.
- b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
 - 2) Communications:
 - 3) Voice and Data Jacks: As specified in Section 271000.
 - 4) Voice and Data Jacks: Provided by others.
5. Dual Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One 2-1/8 inch by 3/4 inch combination threaded opening(s).
 - 2) Communications: One 2-1/8 inch by 1 inch combination threaded opening(s).
6. Accessories:
 - a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
 - b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.
7. Products:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.

2.8 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell.com/#sle.
 2. Thomas & Betts Corporation: www.tnb.com/#sle.
 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.
- C. Above-Floor Service Fittings:
 1. Single Service Pedestal Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle.
 2. Single Service Pedestal Communications Outlets:
 - a. Configuration: One 1 inch bushed opening.
 - b. Voice and Data Jacks: As specified in Section 271000.
 3. Single Service Pedestal Furniture Feed:
 - a. Configuration: One 3/4 inch knockout.
 4. Dual Service Pedestal Combination Outlets:
 - a. Configuration:

- 1) Power: One standard convenience duplex receptacle.
- 2) Communications: One 1 inch bushed opening.
- 3) Voice and Data Jacks: As specified in Section 271000.
- b. Provide barrier to separate line and low voltage compartments.
5. Products:
 - a. Hubbell Incorporated: www.hubbell.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

D. Flush Floor Service Fittings:

1. Single Service Flush Convenience Receptacles:
 - a. Configuration: One standard convenience duplex receptacle(s) with duplex flap opening(s).
2. Single Service Flush Communications Outlets:
 - a. Configuration: _____.
 - b. Voice and Data Jacks: As specified in Section 271000.
3. Single Service Flush Furniture Feed:
 - a. Configuration: One 2 inch by 1-1/4 inch combination threaded opening(s).
4. Dual Service Flush Combination Outlets:
 - a. Cover: Hinged door(s).
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s).
 - 2) Communications:
 - 3) Voice and Data Jacks: As specified in Section 271000.
5. Dual Service Flush Furniture Feed:
 - a. Configuration:
 - 1) Power: One 3/4 inch threaded opening(s).
 - 2) Communications: Two 1/2 inch threaded opening(s).
6. Accessories:
 - a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

2.9 ACCESS FLOOR BOXES

A. Manufacturers - Access Floor Boxes:

1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
2. Thomas & Betts Corporation: www.tnb.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
4. Substitutions: See Section 016000 - Product Requirements.

B. Manufacturers - Access Floor Boxes with Pre-wired Connectors for Manufactured Wiring Systems:

1. AFC Cable Systems Inc: www.afcweb.com/#sle.

2. RELOC Wiring Solutions, a brand of Acuity Brands, Inc: www.relocwiring.com/#sle.
 3. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
 4. Substitutions: See Section 016000 - Product Requirements.
 5. Source Limitations: Provide access floor boxes with pre-wired connectors produced by the same manufacturer as the manufactured wiring system used for this project.
- C. Description: Metallic multi-service box suitable for mounting in access floor system specified in Section 096900.
- D. Access floor boxes with pre-wired connectors for manufactured wiring systems are permitted only where manufactured wiring systems are permitted as specified in Section 260519.
- E. Configuration:
1. Power: Two standard convenience duplex receptacle(s).
 2. Communications:
 3. Voice and Data Jacks: Provided by others.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that core drilled holes for poke-through assemblies are in proper locations.
- H. Verify that openings in access floor are in proper locations.
- I. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Wall Dimmers: 48 inches above finished floor.
 - c. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.
- I. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

- J. Unless otherwise indicated, GFCI receptacles may be connected to provide feed-through protection to downstream devices. Label such devices to indicate they are protected by upstream GFCI protection.
- K. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- L. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- M. Install wall switches with OFF position down.
- N. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- O. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- P. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- Q. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- R. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- S. Identify wiring devices in accordance with Section 260553.
- T. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Inspect each surge protection receptacle to verify surge protection is active.

- G. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 262726

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SECTION 262813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.2 RELATED REQUIREMENTS

- A. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 262413 - Switchboards: Fusible switches.
- C. Section 262416 - Panelboards: Fusible switches.
- D. Section 262419 - Motor-Control Centers: Fusible switches.
- E. Section 262513 - Low-Voltage Busways: Fusible switches.
- F. Section 262816.16 - Enclosed Switches: Fusible switches.
- G. Section 262913 - Enclosed Controllers: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses; Current Edition, Including All Revisions.
- F. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

- G. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.
- H. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Switches for Switchboards: See Section 262413.
 - b. Fusible Switches for Panelboards: See Section 262416.
 - c. Fusible Switches for Motor Control Centers: See Section 262419.
 - d. Fusible Switches for Busway: See Section 262501.
 - e. Fusible Enclosed Switches: See Section 262816.16.
 - f. Fusible Switches for Enclosed Motor Controllers: See Section 262913.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
 - 1. Spare Fuse Cabinet: Include dimensions.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: One set(s) of three for each type and size installed.
 - 3. Fuse Pullers: One set(s) compatible with each type and size installed.
 - 4. Spare Fuse Cabinet Keys: Two.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com/#sle.
- B. Littelfuse, Inc: www.littelfuse.com/#sle.
- C. Mersen: ep-us.mersen.com/#sle.
- D. Substitutions: See Section 016000 - Product Requirements.

2.2 APPLICATIONS

- A. Service Entrance:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- B. Feeders:
 - 1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
 - 2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.
- C. General Purpose Branch Circuits: Class RK1, time-delay.
- D. Individual Motor Branch Circuits: Class RK1, time-delay.
- E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- F. Primary Protection for Control Transformers: Class CC, time-delay.

2.3 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
- H. Class L Fuses: Comply with UL 248-10.
- I. Class CC Fuses: Comply with UL 248-4.

2.4 SPARE FUSE CABINET

- A. Description: Wall-mounted sheet metal cabinet with shelves and hinged door with cylinder lock, suitably sized to store spare fuses and fuse pullers specified.
- B. Finish: Manufacturer's standard, factory applied grey finish unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse cabinet where indicated.
- D. Identify spare fuse cabinet in accordance with Section 260553.

END OF SECTION 262813

SECTION 262816.13 - ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- K. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of circuit breaker upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 - 4. Include documentation of listed series ratings upon request.
 - 5. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Field Quality Control Test Reports.

- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Project Record Documents: Record actual installed locations of enclosed circuit breakers.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.

- E. Substitutions: See Section 016000 - Product Requirements.
- F. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed circuit breakers and associated components suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- E. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
 - 2. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location as determined by short circuit study performed in accordance with Section 260573.
 - 3. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 - 4. Label equipment utilizing series ratings as required by NFPA 70.
- F. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide thermal magnetic circuit breakers unless otherwise indicated.
- I. Provide electronic trip circuit breakers where indicated.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

- K. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
 - 3. Provide surface-mounted enclosures unless otherwise indicated.
- M. Provide externally operable handle with means for locking in the OFF position.
- N. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- O. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. 14,000 rms symmetrical amperes at 480 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 1. Provide compression lugs unless otherwise indicated.
 2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 1. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 2. Provide interchangeable trip units where indicated.
- E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 1. Provide the following field-adjustable trip response settings:
 - a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - b. Long time delay.
 - c. Short time pickup and delay.
 - d. Instantaneous pickup.
 - e. Ground fault pickup and delay where ground fault protection is indicated.
 2. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
 3. Provide communication capability where indicated: Compatible with system indicated.
- F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
- G. Provide the following circuit breaker types where indicated:
 1. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 2. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
 3. Current Limiting Circuit Breakers: Without using fusible elements, designed to limit the let-through energy to a value less than the energy of a one-half cycle wave of the symmetrical prospective current when operating within its current limiting range.
- H. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
- I. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.

- J. Provide the following features and accessories where indicated or where required to complete installation:
1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
 2. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.
 3. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.
 4. Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Provide required seismic controls in accordance with Section 260548.
- F. Install enclosed circuit breakers plumb.
- G. Install flush-mounted enclosed circuit breakers so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- H. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- I. Provide grounding and bonding in accordance with Section 260526.

- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Set field-adjustable circuit breaker tripping function settings as indicated.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Identify enclosed circuit breakers in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
 - 1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.13

SECTION 262816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262813 - Fuses.
- F. Section 262913 - Enclosed Controllers: Manual motor controllers.
- G. Section 263600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- G. Project Record Documents: Record actual locations of enclosed switches.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. General Electric Company: www.geindustrial.com/#sle.
- B. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB/GE: www.geindustrial.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
- D. Siemens Industry, Inc: www.usa.siemens.com/#sle.
- E. Substitutions: See Section 016000 - Product Requirements.

- F. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 260548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
1. Altitude: Less than 6,600 feet.
 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:
1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 2. Minimum Ratings:
 - a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
 - b. General Duty Single Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
 - c. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
 - d. Double Throw Switches Protected by Class R, Class J, or Class T Fuses: 100,000 rms symmetrical amperes.
- H. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- I. Provide with switch blade contact position that is visible when the cover is open.
- J. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

- K. Conductor Terminations: Suitable for use with the conductors to be installed.
- L. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- M. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- N. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- O. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- P. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position where indicated.
- Q. General Duty Switches:
 - 1. Conductor Terminations:
 - a. Provide mechanical lugs.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 2. Provide externally operable handle with means for locking in the OFF position, capable of accepting two padlocks.
- R. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.
 - 2. Integral fuse pullers.
 - 3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
 - 4. Viewing Window: Positioned over switch blades for visual confirmation of contact position with door closed.

5. Interlocked Receptacle: Integral pre-wired three phase, three wire, grounded type receptacle interlocked with switch mechanism to prevent insertion or removal of plug with switch in the ON position and to prevent switch from being placed in the ON position without matching plug inserted. Provide receptacle configuration as required to accept plug as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 260529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 260526.
- H. Provide fuses complying with Section 262813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Identify enclosed switches in accordance with Section 260553.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.16

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SECTION 263100 - PHOTOVOLTAIC COLLECTORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Photovoltaic system requirements.
- B. Photovoltaic modules.
- C. Photovoltaic module mounting system.
- D. Photovoltaic combiner boxes.
- E. Photovoltaic inverters.
- F. Monitoring system.

1.2 RELATED REQUIREMENTS

- A. Section 260519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 262100 - Low-Voltage Electrical Service Entrance.
- F. Section 262200 - Low-Voltage Transformers: Isolation transformers not integral to inverters.
- G. Section 262813 - Fuses.
- H. Section 264300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. IEC 61215-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1: Test Requirements; 2016.
- B. IEC 61215-1-1 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 1-1: Special Requirements for Testing of Crystalline Silicon Photovoltaic (PV) Modules; 2016.

- C. IEC 61215-2 - Terrestrial Photovoltaic (PV) Modules - Design Qualification and Type Approval - Part 2: Test Procedures; 2016.
- D. IEEE 1547 - Standard for Interconnecting Distributed Resources with Electric Power Systems; 2003, with Amendment 1, 2014.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NECA 412 - Standard for Installing and Maintaining Photovoltaic (PV) Power Systems; 2012.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- J. UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection; Current Edition; Current Edition, Including All Revisions.
- K. UL 1703 - Flat Plate Photovoltaic Modules and Panels; Current Edition, Including All Revisions.
- L. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for photovoltaic system components.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week prior to commencing work of this section; require attendance of all affected installers. Include adequate instruction on the electrical hazards associated with photovoltaic systems and appropriate safety procedures to be followed.
- C. Rebates and Incentives: Prepare and submit documentation as required for Owner to secure funds from available federal, state, and utility company rebate and incentive programs. Notify Owner of any time constraints affecting program qualification.
- D. Utility Interconnection:

1. See Section 262100 for Utility Company contact information and additional requirements.
2. Prepare and submit documentation as required for securing utility interconnection agreement between Owner and Utility Company.
3. Preinstallation Meeting: Convene one week prior to commencing work of this section to review interconnection requirements and details with Utility Company representative.
4. Coordinate with Utility Company to provide utility metering suitable for system requirements.
5. Arrange for inspections and secure permits necessary to obtain Utility Company approval of system.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, attachment locations and details, and proposed size, type, and routing of conduits and cables. Include system interconnection schematic diagrams showing all factory and field connections.
- D. Design Data:
 1. Include structural calculations, certified by structural engineer, for equipment and mounting system.
 2. Include electrical calculations for array and associated equipment other than the basis of design products and configuration.
- E. Certify that products of this section meet or exceed specified requirements.
- F. Certify that work of this section does not void roof warranty.
- G. Installer's Qualifications: Include evidence of compliance with specified requirements.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- I. Manufacturer's detailed field testing procedures.
- J. Manufacturer's detailed startup procedures.
- K. Field quality control test reports.
 1. Include manufacturer's field reports.

- L. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- M. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- N. Maintenance contracts.
- O. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- P. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Photovoltaic Modules: Two.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with Utility Company requirements for interconnection.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience with photovoltaic systems of similar size, type, and complexity.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Specified warranties indicate minimum requirements. Provide additional warranties or extended warranty periods where required to qualify for rebate and incentive programs.
- C. Photovoltaic Modules:
 - 1. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

2. Provide manufacturer warranty guaranteeing minimum 90 percent of rated power output for 10 years and minimum 80 percent of rated power output for 20 years.
- D. Photovoltaic Module Mounting System: Provide minimum 10 year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- E. Photovoltaic Combiner Boxes: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- F. Photovoltaic Inverters: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- G. Charge Controllers: Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Photovoltaic Modules - Basis of Design: As indicated on Drawings.

2.2 PHOTOVOLTAIC SYSTEM REQUIREMENTS

- A. Provide complete photovoltaic system consisting of photovoltaic modules and associated balance of system components necessary for connection to facility electrical system.
- B. System Description:
 1. Photovoltaic array is mounted in location indicated on the drawings.
 2. Orientation of array is as indicated on the drawings.
 3. Photovoltaic DC system is negative grounded.
 4. System includes interconnection with utility grid (grid-tied system).
 - a. Utility metering configuration: Net metering.
 5. System does not include battery storage system.
 6. System does not include engine generator.
 7. System includes DC system surge protection.
 8. System includes monitoring system.
- C. Capacity:
 1. Total Nominal Rated Power Output of Array: Equal to or greater than the rated output of the basis of design array.
- D. Size:
 1. Array: Designed to fit within the area designated on the drawings.
 2. Individual Modules: Size is not critical.
- E. Appearance:

1. Only systems with similar appearance to basis of design system will be considered.
 2. Arrange array such that modules are aligned with uniform spacing.
 3. Make no alterations affecting appearance of building exterior or interior without approval of Architect.
 4. Final determination of acceptable appearance is by Architect.
- F. Fire Resistance Rating: Provide photovoltaic module and mounting system combination that together with the roof covering form a system listed in accordance with UL 1703 to provide a fire rating equal to or better than the required fire rating of the roof.
- G. Provide photovoltaic system and associated components suitable for wind loads, snow loads, seismic loads, and other structural design considerations of the installed location.
- H. Provide photovoltaic system and associated components suitable for continuous operation under the service conditions at the installed location.
- I. Provide products listed, classified, and labeled as suitable for the purpose intended.
- J. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system.
- K. DC Arc Fault Circuit Protection: Provide DC photovoltaic arc-fault protection devices listed as complying with UL 1699B as required for compliance with NFPA 70.
- L. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- M. Arrange array to minimize shading during peak production periods.

2.3 PHOTOVOLTAIC MODULES

- A. Acceptable Module Types: Only crystalline silicon modules are acceptable. Thin film modules will not be considered for this project.
- B. General Requirements:
1. Photovoltaic Modules: Factory assembled; consisting of photovoltaic cells, frame, junction box, cables for series connection, and bypass diodes for shade tolerance; rated for 600 V DC; complying with IEC 61215-1 and IEC 61215-2 and listed as complying with UL 1703.
 2. Crystalline Silicon Photovoltaic Modules: Comply with IEC 61215-1-1.
 3. Frame: Anodized aluminum.
 4. Factory-Installed Junction Box: Weatherproof, with factory-installed terminals and bypass diodes.
 5. Factory-Installed Cables: Type USE-2 or listed photovoltaic (PV) wire with polarized locking connectors.

6. Unless otherwise indicated, specified module performance characteristics are rated under Standard Test Conditions (STC).

2.4 BALANCE OF SYSTEM COMPONENTS

A. Photovoltaic Module Mounting System:

1. Provide complete mounting system compatible with modules to be installed and suitable to properly install them in the location indicated, including all necessary hardware and accessories.
2. Support Structure and Associated Hardware Materials: Use aluminum, galvanized steel, or stainless steel.
3. Roof-Mounted Arrays:
 - a. Acceptable System Types: Either non-penetrating or penetrating systems complying with specified requirements will be considered for this project.
 - b. Provide system compatible with the roof at the installed location.
 - c. Module Tilt Angle: As required to provide maximum energy production for installed location.
 - d. Provide minimum clearance of 3 inches between roof and module for air circulation and drainage.

B. Photovoltaic Combiner Boxes:

1. Provide combiner box(es) for termination of strings as indicated or as required for the array configuration installed.
2. Combiner Boxes: Rated for 600 V DC; current ratings suitable for connected strings; equipped with fuseholders; listed as complying with UL 1741.
3. Fuseholders: Touch-safe; suitable to accept fuses indicated.
4. Number of Input Circuits: As indicated or as required for termination of strings, with minimum of 25 percent spare capacity for future expansion.
5. Enclosure: NEMA 250, Type 3R, unless otherwise indicated.
6. Provide integral load-break rated disconnect.
7. Provide with capability of current monitoring for individual strings.

C. Photovoltaic Inverters:

1. Provide inverter(s) as indicated or as required for connection of the photovoltaic array DC system to the AC system indicated.
2. Inverters: Suitable for the requirements of the connected array; output configuration compatible with connected system; listed as complying with UL 1741; furnished with the following features:
 - a. Maximum power point tracking (MPPT).
 - b. LCD display.
 - c. Integral AC disconnect.
 - d. Integral DC disconnect.
 - e. Integral DC ground fault detection and interruption (GFDI).
 - f. Communications Interface: As required for connection to system indicated.

3. Grid-Tied Inverters: Comply with IEEE 1547, including over/under grid voltage and frequency protection, and anti-islanding protection to automatically disconnect upon loss of utility power and to remain disconnected until utility power restoration has been maintained for five minutes.
 4. Grounded Photovoltaic DC Systems: Furnish with integral isolation transformer. Transformerless inverters may be used if a separate isolation transformer is provided.
 5. Total Harmonic Distortion: Less than five percent.
 6. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- D. Surge Protective Devices, in Addition to Requirements of Section 264300:
1. Surge Protective Devices for DC System:
 - a. Rated for 600 V DC.
 - b. Listed and labeled as complying with UL 1449, Type 1.
 - c. Surge Current Rating: Not less than 50 kA per mode.
 - d. UL 1449 Nominal Discharge Current (I-n): 20 kA.
- E. Monitoring System:
1. Provide a system to monitor photovoltaic system performance including all sensors, dataloggers, connections, software, equipment and accessories necessary for a complete operating system.
 2. System communications interfaces to be wired or wireless, with compatible interconnected components.
 - a. Provide suitable raceway, minimum 3/4 inch trade size, for all required wired connections.
 3. System to monitor and record, in 15 minute intervals:
 - a. Inverter status.
 - b. Instantaneous power (kW).
 - c. Cumulative energy production (kWh).
 4. System real-time and historical data to be accessible from the following locations:

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Use open circuiting, short circuiting, or opaque covering to disable modules, array or portions of array prior to installation and service.
- B. Roof-Mounted Arrays: Protect roof and adjacent roof-mounted items from damage.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment in accordance with Section 260529.
- D. Mount equipment such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor, ground, or working platform.
- E. Circuiting Requirements. in Addition to Requirements of Section 260519:
 - 1. Photovoltaic DC System Conductor Color Code:
 - a. Negative Grounded System:
 - 1) Positive: Red.
 - 2) Negative/Grounded: White.
 - 2. Maintain separation of photovoltaic and non-photovoltaic circuits in accordance with NFPA 70.
- F. Grounding and Bonding Requirements, in Addition to Requirements of Section 260526:
 - 1. Ensure that there is only one AC System bonding connection between grounding system and grounded/neutral conductor, including external connections and connections internal to equipment.
 - 2. Grounded DC Systems: Ensure that there is only one point of system grounding connection to the grounded conductor, including external connections and connections internal to equipment.
- G. Identification Requirements, in Addition to Those Specified in Section 260553:
 - 1. Use identification nameplate or means of identification acceptable to authority having jurisdiction to identify the presence of multiple power sources and the location of main service disconnecting means and each photovoltaic system disconnecting means. Locate at main service disconnecting means and at each photovoltaic system disconnecting means. Verify format and descriptions with authorities having jurisdiction.
 - 2. Use identification nameplate to identify each photovoltaic system disconnecting means with text "PV SYSTEM DISCONNECT".
 - 3. Use identification nameplate or identification label to identify systems equipped with rapid shutdown and associated rapid shutdown switch(es). Format, descriptions, and locations to comply with NFPA 70 and requirements of authorities having jurisdiction.

4. Use identification nameplate or identification label to identify the information required by NFPA 70 for marking of direct-current photovoltaic power sources. Locate at each DC disconnect means requiring marking.
5. Use identification nameplate or identification label to identify the interactive system point of interconnection at the disconnecting means as a power source and with the rated AC output current and the nominal operating AC voltage.
6. Use warning labels to identify electrical hazards for photovoltaic system disconnecting means. Include the word message "Warning - Electric Shock Hazard; Terminals on the line and load sides may be energized in the open position" or approved equivalent.
7. Use wire and cable markers to identify photovoltaic system source, output, and inverter circuit conductors at all points of termination, connection, and splices.
8. Use voltage markers, identification labels, stenciled text, or suitable permanent marking approved by authority having jurisdiction to identify exposed raceways, cable trays, pull boxes, junction boxes, and conduit bodies with the text "Warning: Photovoltaic Power Source" at maximum intervals of 10 feet in accordance with NFPA 70.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. See article "SYSTEM STARTUP" below for additional requirements related to testing and inspection.
- C. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- D. Inspection and testing to include, at a minimum:
 1. Inspect each system component for damage and defects.
 2. Verify that equipment enclosures, boxes, and associated connections installed outdoors are weatherproof.
 3. Verify proper wiring connections have been made and check for conductor continuity. Verify proper polarity.
 4. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 5. Measure and record voltages at the inverter AC and DC inputs.
 6. Measure and record AC output power.
 7. Perform inverter functional test.
 - a. Grid-Tied Inverters: Include simulation of loss of utility power and subsequent power restoration.
 8. Verify proper operation of monitoring system.
- E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.5 SYSTEM STARTUP

- A. Provide services of a manufacturer's authorized representative to assist in performing system startup. Include manufacturer's detailed startup procedures with submittals.
- B. Obtain Owner's approval prior to performing system startup.
- C. Grid-Tied Systems: Obtain Utility Company's approval prior to performing system startup.
- D. Prepare and start system in accordance with manufacturer's instructions.

3.6 CLEANING

- A. Clean modules using only methods recommended by manufacturer to avoid scratches and other damage. Clean exposed surfaces on other components to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of photovoltaic system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.

3.8 PROTECTION

- A. Protect installed products from subsequent construction operations.

3.9 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner, a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of photovoltaic system for two years from date of Substantial Completion, to include the work described below; Include a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.

- C. Conduct site visit at least once every six months to perform inspection, testing, and preventive maintenance. Conduct tests similar to those made during original field quality control testing. Submit report to Owner comparing test results with those of original tests along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

END OF SECTION 263100

SECTION 263323 - CENTRAL BATTERY EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Emergency power supply.
- B. Uninterruptible power supply (UPS) centralized emergency lighting inverters.
- C. Remote trouble alarm indicator.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260529 - Hangers and Supports for Electrical Systems.
- C. Section 265100 - Interior Lighting:
- D. Section 265600 - Exterior Lighting: Luminaires for interface with centralized emergency lighting inverters.

1.3 REFERENCE STANDARDS

- A. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

1.4 EMERGENCY POWER SUPPLY

- A. NFPA 101 - Life Safety Code; 2015.

1.5 RATINGS

- A. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems; 2013.
- B. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- C. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.6 ADMINISTRATIVE REQUIREMENTS

- A. Inverter Output Frequency: 60 Hz plus 1 percent.
- B. Coordination:

- C. Efficiency: 90 percent minimum.
- D. Maximum Recharge Time: 12 hours following 1.5 hour discharge.
- E. Total Harmonic Distortion: Less than 10 percent at full resistive load.
- F. Battery: Nickel cadmium, sealed type battery.
- G. Accessories: Provisions for remote battery alarm.
- H. Instrumentation and Alarms: NFPA 111.
- I. Charger: Dual rate, designed to maintain battery in full-charge condition during normal conditions.
- J. Coordination:
 - 1. Coordinate compatibility of centralized emergency lighting inverters to be installed with work provided under other sections or by others.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 3. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.7 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
- C. Shop Drawings: Indicate dimensions, input/output voltages, power ratings, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, and installed features and accessories.
- D. Specimen Warranty: Submit sample of manufacturer's warranty.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

- F. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- G. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- H. Maintenance contracts.
- I. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Enclosure Keys: Two of each different key.
 - 3. Battery Fuses: See Section 262813 for requirements for spare fuses and spare fuse cabinets.

1.8 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 101 (Life Safety Code).
 - 3. NFPA 111; meet requirements for Level 1 system.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with centralized emergency lighting inverter systems of similar size, type, and complexity; manufacturer's authorized installer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to inverter system components, enclosure, and finish.

- D. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

1.10 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.11 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Inverter Assemblies: Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- C. Batteries: Provide pro-rata warranty for the duration of rated design life.

PART 2 PRODUCTS

2.1 CENTRALIZED EMERGENCY LIGHTING INVERTERS - GENERAL REQUIREMENTS

- A. Provide complete centralized emergency lighting inverter system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Inverter Assemblies: Manufactured units consisting of inverters, batteries, enclosures, and associated components specifically designed for emergency lighting applications; microprocessor-based utilizing pulse width modulation (PWM) with insulated gate bipolar transistors (IGBT's); listed and labeled as complying with UL 924.
 - 1. Battery Run Times of 90 Minutes: Listed as complying with UL 924 for "emergency lighting and power equipment".
 - 2. Battery Run Times Other than 90 Minutes: Listed as complying with UL 924 for "auxiliary lighting and power equipment".
- D. Provide inverters and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Increase indicated power ratings as required to accommodate any applicable inverter load restrictions.
- F. Inverters Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.

G. Battery System:

1. Provide battery capacity as required for achieving battery run time indicated.
2. Battery Charger: Microprocessor-controlled, temperature compensated; capable of returning supplied battery(s) from fully discharged to fully charged condition within time required by NFPA 111 and UL 924 unless otherwise indicated.
3. Provide automatic low voltage battery disconnect to prevent battery "deep discharge" damage.

H. Enclosures:

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
2. Hinged Doors: Lockable, with all locks keyed alike.
3. Finish: Manufacturer's standard unless otherwise indicated.

I. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category B.

J. Automatic Sequence of Operations:

1. Upon failure or degradation of primary/normal input power, transfer load to battery power.
2. When primary/normal input power has been restored, retransfer load to primary/normal power and recharge battery.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of inverter assemblies are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive inverter assemblies.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install inverter assemblies in accordance with applicable requirements of NECA 416.
- C. Install products in accordance with manufacturer's instructions.
- D. Arrange equipment to provide minimum clearances and required maintenance access.

- E. Provide required support and attachment in accordance with Section 260529.
- F. Install inverter assemblies plumb and level.
- G. Unless otherwise indicated, mount floor-mounted inverter assemblies on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- C. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- D. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank.
- E. Prepare and start system in accordance with manufacturer's instructions.
- F. Perform acceptance test in accordance with NFPA 111.
- G. Inspect and test in accordance with NETA ATS, except Section 4.
- H. Perform inspections and tests listed in NETA ATS, Section 7.22.2.
- I. Batteries and Charger: Perform inspections and tests listed in NETA ATS, Section 7.18.
- J. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of emergency lighting inverter system to Owner, and correct deficiencies or make adjustments as directed.
- B. Training: Train Owner's personnel on operation, adjustment, and maintenance of emergency lighting inverter system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Location: At project site.

3.6 PROTECTION

- A. Protect installed inverter assemblies from subsequent construction operations.

3.7 MAINTENANCE

- A. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of emergency lighting inverter system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.

END OF SECTION 263323

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SECTION 263999 - BATTERY ENERGY STORAGE SYSTEMS (BESS)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Battery Energy Storage System

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 263100 - Photovoltaic Systems: For use in conjunction with battery energy storage systems specified in this section.
- G.
- H.

1.3 REFERENCE STANDARDS

- A. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).

1.4 EMERGENCY POWER SUPPLY

- A. NFPA 101 - Life Safety Code; 2015.

1.5 RATINGS

- A. NFPA 111 - Standard on Stored Electrical Energy Emergency and Standby Power Systems; 2013.
- B. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- C. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
 - 1. Where applicable, include characteristic trip curves for overcurrent protective devices upon request.
- C. Provide interconnection between cabinets.
 - 1. Indicate any inverter load restrictions.
 - 2. Identify mounting conditions required for equipment seismic qualification.
- D. Shop Drawings: Indicate dimensions, input/output voltages, power ratings, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, and installed features and accessories.
- E. Specimen Warranty: Submit sample of manufacturer's warranty.
- F. Evidence of qualifications for manufacturer.
- G. Evidence of qualifications for installer.
- H. Evidence of qualifications for maintenance contractor (if different entity from installer).
- I. Manufacturer's equipment seismic qualification certification.
- J. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- K. Manufacturer's certification that products meet or exceed specified requirements.
- L. Source quality control test reports.
- M. Provide NFPA 111 required documentation from manufacturer where requested by authorities having jurisdiction.
- N. Manufacturer's detailed field testing procedures.
- O. Field quality control test reports.
- P. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- Q. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- R. Maintenance contracts.
- S. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.7 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
 2. NFPA 101 (Life Safety Code).
 3. NFPA 111; meet requirements for Level 1 system.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 1. Authorized service facilities located within 200 miles of project site.
 2. ISO 9001 certified.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with centralized emergency lighting inverter systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 1. Contract maintenance office located within 200 miles of project site.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to inverter system components, enclosure, and finish.
- D. Do not exceed maximum ambient temperature requirements for batteries at any time, which reduces battery service life. Replace batteries exposed to temperatures in excess of manufacturer's requirements.

1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Inverter Assemblies: Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.
- C. Batteries: Provide pro-rata warranty for the duration of rated design life.

PART 2 PRODUCTS - BATTERY ENERGY STORAGE SYSTEM

GOAL:

A. POWER DEMAND MODE—RESPOND TO EXTERNAL POWER DEMAND

MAXIMUM SYSTEM VOLTAGE: 1500V

PV SYSTEM SHOULD BE DESIGNED TO PROVIDE 120KW DC_p POWER USING A DC COUPLED BATTERY SYSTEM THAT CAN PROVIDE 500KWH DC / 467.239 KWH-AC OF ENERGY WITH THE MAX. POSSIBLE PEAK POWER OF 170KW DURING A 24HR POWER OUTAGE PERIOD. PV SYSTEM SHOULD ALSO PROVIDE 193,000 KWH/YEAR TO OFFSET THE FACILITY ENERGY CONSUMPTION. PV + BATTERY SYSTEM SHOULD PROVIDE THE POSSIBILITY OF CONNECTING A PORTABLE DIESEL GENERATOR TO THE SWITCHBOARD WHEN NEEDED. THE PARALLEL OPERATION OF THE PV + BATTERY SYSTEM AND THE PORTABLE DIESEL GENERATOR IS PROHIBITED.

WARRANTY:

REFER TO THE ATTACHED 10-YEAR O&M FOR DETAILS.

PV PANELS:

MANUFACTURED UNITS:

A. MANUFACTURERS: SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE PRODUCTS BY THE FOLLOWING:

B. SUBJECT TO COMPLIANCE WITH REQUIREMENTS, PROVIDE HANWHA Q-CELLS Q.PEAK DUO XL-G10.2 480W OR COMPARABLE PRODUCT.

PERFORMANCE REQUIREMENTS:

A. NRTL (NATIONALLY RECOGNIZED TESTING LABORATORY) LISTING: ENTIRE ASSEMBLY SHALL BE LISTED AND LABELED BY A QUALIFIED TESTING AGENCY ACCEPTABLE TO AUTHORITIES HAVING JURISDICTION FOR ELECTRICAL AND FIRE SAFETY, CLASS A ACCORDING TO UL 1703.

SYSTEM SIZE, CHARACTERISTICS & SPECIFICATIONS:

- A. TOTAL SYSTEM SIZE: 120KW DC
- B. TOTAL ENERGY YIELD: MINIMUM 193,000 KWH
- C. MINIMUM ELECTRICAL CHARACTERISTICS:

RATED OPEN CIRCUIT VOLTAGE (VOC): 53.61

MAXIMUM SYSTEM VOLTAGE: 1500V

MAXIMUM POWER AT VOLTAGE (VPM): 44.81

RATED SHORT-CIRCUIT CURRENT (ISC): 11.26

RATED OPERATION CURRENT (IMP): 10.71

MAXIMUM POWER AT STC (P_{MAX}): 480W

MODULE EFFICIENCY: 20.7%

POWER TOLERANCE: +5W/-0W

MINIMUM REVERSE CURRENT: 20A

PV MODULE CLASSIFICATION: CLASS II

FIRE RATING BASED ON ANSI/UL 61730: C/TYPE 1

PERMITTED MODULE TEMPERATURE ON CONTINUOUS DUTY: -40°C/+85°C

MECHANICAL SPECIFICATIONS:

- A. FORMAT (INCLUDING FRAME): 2216MM X 1045MM X 35MM
- B. WEIGHT: 26.5KG
- C. FRONT COVER CONSTRUCTION: 3.2MM THERMALLY PRE-STRESSED GLASS WITH ANTI-REFLECTION TECHNOLOGY
- D. BACK COVER CONSTRUCTION: COMPOSITE FILM
- E. FRAME CONSTRUCTION: ANODISED ALUMINUM
- F. CELL: 6 X 26 MONOCRYSTALLINE Q. ANTUM SOLAR HALF CELLS
- G. JUNCTION BOX: 53-101MM X 32-60MM X 15-18MM PROTECTION CLASS IP67, WITH BYPASS DIODES
- H. CABLE: 4 MM² SOLAR CABLE; (+)≥70MM, (-)350MM
- I. CONNECTOR: STÄUBI MC4-EVO2, HANWHA Q CELLS HQC4; IP68

CARPORT:

MATERIAL: STRUCTURE FRAME: COLD GALVANIZED HI TENSILE 55 KSI BOX BEAM PLATE TO PLATE.

FRAMING: SQUARE AND COLD-FORMED CHANNELS SHALL BE BOLTED/TEKED TOGETHER IN THE FIELD WITHOUT ADDITIONAL FABRICATIONS OR FIELD WELDING.

COLUMNS: COLUMNS SHALL BE IMBEDDED IN CONCRETE PIER FOOTING.

ROOFING: ROOFING SHALL BE SECURED WITH SELF-TAPPING SCREWS. STRUCTURES UP TO 40' DEEP SHOULD USE SINGLE ROOF RUNNING FROM FRONT TO REAR, SO END LAPS ARE ELIMINATED.

DRAINAGE: 5 DEGREE ROOF SLOPE TO FRONT OR REAR AS REQUIRED.

DESIGN STANDARD: ALL LIGHT GAUGE COLD-FORMED STRUCTURAL PANELS SHALL BE DESIGNED IN ACCORDANCE WITH THE SPECIFICATIONS FOR THE DESIGN OF "LIGHT GAUGE COLD-FRAMED STRUCTURAL MEMBERS" AS PUBLISHED BY THE AMERICAN IRON AND STEEL INSTITUTE.

WIND LOAD: STRUCTURES SHALL BE DESIGNED PER SITE SPECIFIC CURRENT CODE REQUIREMENTS.

ROOF LOAD: STRUCTURES SHALL BE DESIGNED PER SITE SPECIFIC CURRENT CODE REQUIREMENTS.

ROOFING: DEEP-RIB PANELS SHALL BE COLD-FORMED FROM HI-TENSILE LIGHT GAUGE STEEL WITH A MINIMUM YIELD POINT OF 80,000/ 50,000 OR 33,000 PSI STEEL OF EQUIVALENT SECTION PROPERTIES. PANELS SHALL BE FURNISHED WITH A GALVANIZED FINISH.

HARDWARE AND ACCESSORIES: GALVANIZED OR CHROMATE-DIPPED HARDWARE FURNISHED WITH ONE PERCENT (1%) EXCESS.

FOUNDATION WORK: DRILLING PIER FOOTING AND CONCRETE PLACEMENT. ASSUME 2000 PSI SOIL BEARING PRESSURE. DRILLED FOOTINGS SHALL BE FURNISHED WITH A SMALL CONCRETE CROWN AROUND THE STEEL COLUMN FOR PROPER RUN-OFF.

INVERTER (PCS-POWER CONDITIONING SYSTEM):

INVERTER OUTPUT SHALL INTERCONNECTS WITH THE POWER GRID AND PROVIDES FLEXIBILITY FOR VARIOUS FUNCTION CONFIGURATIONS:

A. POWER DEMAND MODE—RESPOND TO EXTERNAL POWER DEMAND

IN POWER DEMAND MODE, INVERTER SHALL RESPOND TO THE EXTERNAL POWER DEMANDS AND PROVIDES THE REQUIRED ACTIVE/REACTIVE POWER TO THE GRID.

B. PEAK SHAVING MODE—SCHEDULING PEAK SHAVING FOR DEMAND CHARGE REDUCTION

IN PEAK SHAVING MODE, ONCE DETECTING THE LOAD CONSUMPTION EXCEEDING THE USER-CONFIGURED LIMIT VALUE, THE INVERTER WILL DISPATCH BATTERY POWER TO SHAVE THE PEAK AND AVOID HIGH DEMAND CHARGE.

C. GRID SUPPORT MODE—IMPROVE GRID POWER QUALITY

INVERTER SHALL ACTIVELY COMPENSATE POOR GRID VOLTAGE AND FREQUENCY BY PROVIDING ACTIVE OR REACTIVE POWER. THE COMPENSATION RATIO SHOULD BE USER CONFIGURABLE.

D. STANDALONE MODE—A RELIABLE BACKUP POWER

ONCE DETECTING GRID BLACKOUTS, THE INVERTER SHALL DISCONNECT FROM THE GRID AND TRANSITION TO STANDALONE MODE, AND CONTINUOUSLY PROVIDE QUALITY POWER FROM BATTERY TO THE CRITICAL LOAD TO REDUCE THE LOSS OR DAMAGE CAUSED BY SUCH GRID ABNORMAL SITUATION.

MANUFACTURED UNITS:

A. MANUFACTURER: DELTA PCS125

B. QUANTITY: 2

C. TOTAL CAPACITY: 250 KW

INVERTER SPECIFICATIONS:

AC GRID CONNECTION:

- A. RATED GRID VOLTAGE: 480VAC, 3 PHASE
- B. GRID VOLTAGE RANGE: 423 TO 528 VAC (-12%, +10%)
- C. RATED GRID FREQUENCY: 60HZ
- D. FREQUENCY RANGE: 59.3 HZ TO 60.5 HZ, ADJUSTABLE
- E. RATED AC POWER: 125 KVA
- F. RATED AC CURRENT: 150.4 A
- G. MAX. CONTINUOUS AC CURRENT: 167 ARMS
- H. CURRENT THD: IEEE 1547 COMPLIANT, <5% AT RATED POWER
- I. POWER FACTOR: -1 TO 1, CONTINUOUSLY ADJUSTABLE

DC CONNECTION:

- A. DC VOLTAGE RANGE: 750 TO 1000 VDC
- B. RATED DC VOLTAGE: 900 VDC
- C. RATED DISCHARGE POWER: 129 KW
- D. RATED CHARGE POWER: 122 KW
- E. MAX. DISCHARGE DC CURRENT: 172 A (129 KW @ 750 VDC)
- F. MAX. CHARGE DC CURRENT: 163 A (122 KW @ 750 VDC)

STANDALONE OPERATION:

- A. RATED OUTPUT VOLTAGE: 80 VAC, 3P3W (IN 3P4W CASE, AN EXTERNAL DYN TRANSFORMER IS REQUIRED)

B. RATED OUTPUT POWER: 125 KVA/125 KW WITH LINEAR LOAD /
100 KVA WITH NON-

LINEAR/RCD LOAD

C. RATED OUTPUT CURRENT: 150.4 A WITH LINEAR LOAD / 120A
WITH NON-LINEAR/RCD LOAD

D. RATED OUTPUT FREQUENCY: 60 HZ \pm 1%

E. POWER FACTOR: 0.8 TO 1

F. OUTPUT VOLTAGE ACCURACY: 1%

G. OUTPUT VOLTAGE THD: <3% @ 12.5~100% LINEAR LOAD / <5%
@ 12.5~100% NON-

LINEAR LOAD

H. OUTPUT VOLTAGE REGULATION: <10%, AT DYNAMIC;
RECOVERING WITHIN TOLERANCE 10

100MS

ENVIRONMENTAL:

A. MAX. ALTITUDE: 3,000 M (9,843 FT)

B. OPERATING TEMPERATURE: -25~60°C (-13~140°F), DERATING
>50°C (3%/°C), \leq 200M /

-25~40°C (-13~104°F), >2000M

C. STORAGE TEMPERATURE: -25~70°C (-13~158°F)

D. HUMIDITY: 0 TO 95% RH, NO-CONDENSING

E. COOLING: FORCED AIR W/ SPEED CONTROL

F. ACOUSTIC NOISE: <72 DBA @ 1M (6.6 FT) AT RATED CONDITION

G. ENCLOSURE TYPE: TYPE 3R (IP54 EQUIVALENT)

H. INGRESS RATING: IP54

INTERFACE:

A. USER INTERFACE: 4.9 IN LCD SCREEN WITH OPERATION
BUTTON, FAULT LEDS

B. EMERGENCY STOP: LOCAL EPO BUTTON & REMOTE CONTROL

C. COMMUNICATION: RS-485 / MODBUS RTU, CAN

PERFORMANCE:

A. PEAK EFFICIENCY / CEC EFFICIENCY: 97.8% / 97.5%

B. STANDBY LOSS: <20 W

MECHANICAL:

A. DIMENSIONS (W X D X H): 23.6 IN X 31.5 IN X 68.3 IN

B. NET WEIGHT: 672 LBS

COMPLIANCE:

A. CERTIFICATE: UL1741, UL1741 SA, IEEE1547, RULE 21, FCC PART
15 CLASS A

BATTERY SYSTEM:

MANUFACTURED UNITS:

A. MANUFACTURER: SYL 1P 280S, 251 KWH

B. QUANTITY: 2

C. TOTAL BATTERY SYSTEM CAPACITY: 502 KWH

BATTERY CELL SPECIFICATIONS:

A. MAKE: CATL

B. BATTERY CHEMISTRY: LFP

C. SHAPE: PRISMATIC

D. DIMENSION: 173.9 MM W X 71.7 MM D X 207.2 MM H

E. WEIGHT: 5.34 ± 0.3 KG

F. NOMINAL CAPACITY: 280 AH

- G. NOMINAL ENERGY: 896 WH
- H. NOMINAL VOLTAGE: 3.2 VDC
- I. OPERATING VOLTAGE: 2.8 ~ 3.6 VDC
- J. OPERATING TEMPERATURE RANGE: CHARGE 6~60°C / DISCHARGE -20~60°C
- K. CERTIFICATES: UL 9540A, UN38.3, IEC62619
- L. ACTIVE PROTECTION: SHORT CIRCUIT, OVER-CHARGING, OVER-DISCHARGING, HIGH TEMPERATURE, EXTRUSION, AND OTHER SAFETY FEATURES.

MODULE SPECIFICATIONS:

- A. MAKE: SYL
- B. CONFIGURATION: 1P 10S
- C. KEY COMPONENT: 10 CELLS, MODULE BMU
- D. DIMENSION: 220 MM W X 230 MM D X 990 MM H
- E. WEIGHT: 70 KG
- F. NOMINAL CAPACITY: 280 AH
- G. NOMINAL ENERGY: 8.96 KWH
- H. NOMINAL VOLTAGE: 32 VDC
- I. OPERATING VOLTAGE: 28.0 ~ 36.0 VDC
- J. MAXIMUM POWER: 4.48 KW
- K. STORAGE TEMPERATURE: -30~60°C
- L. STORAGE HUMIDITY: ≤85%

BATTERY RACK SPECIFICATIONS:

- A. MAKE: SYL
- B. CONFIGURATION: 1P 280S
- C. NUMBER OF MODULES: 28
- D. KEY COMPONENT: 28 MODULES, 1 BSPU

- E. SWITCHGEAR POSITION: TOP
- F. DIMENSION: 1,480 MM W X 2,330 MM D X 1,390 MM H
- G. WEIGHT: 3,000 KG
- H. NOMINAL CAPACITY: 280 AH
- I. NOMINAL ENERGY: 250.88 KWH
- J. NOMINAL VOLTAGE: 896 VDC
- K. OPERATING VOLTAGE: 784 ~ 1,008 VDC
- L. MAXIMUM POWER: 63 (0.25CP) KW
- M. OPERATING TEMPERATURE RANGE: CHARGE 0~45°C / DISCHARGE -20~45°C
- N. STORAGE TEMPERATURE: -30~55°C
- O. STORAGE HUMIDITY: ≤95%
- P. DEGREE OF PROTECTION: IP54

BATTERY MANAGEMENT SYSTEM:

BESS SHALL EMPLOY A SOPHISTICATED, MULTILEVEL BATTERY MANAGEMENT SYSTEM (BMS) FOR SYSTEM MONITORING AND CONTROL. EACH BATTERY MANAGEMENT SYSTEM SHOULD INCLUDE:

- A. MODULE BATTERY MANAGEMENT UNIT (BMU)
- B. RACK BATTERY MANAGEMENT CONTROLLING SYSTEM (RBMS)
- C. SYSTEM-LEVEL BMS (SMBS)

ENERGY MANAGEMENT SYSTEM (EMS):

MANUFACTURED UNITS:

- A. MANUFACTURER: MOTIVE ENERGY
- B. QUANTITY: 1

MAJOR COMPONENTS:

- A. POC-515 AMD RYZEN V1605B ULTRA-COMPACT EMBEDDED QUAD-CORE 15W/45W CPU
- C. ADVANTECH SMARTSTART SL302 4G LTE CELLULAR ROUTER & GATEWAY
- D. WALL-MOUNT TYPE NEMA 4 ENCLOSURE
- E. CONTROL-BY-WEB X-400 WEB ENABLED IO CONTROLLER AND X17 EXPANSION MODULES

SPECIFICATIONS:

- A. DIMENSIONS: 30 IN H X 30 IN W X 12 IN D
- B. WEIGHT: 120 LBS
- C. AC POWER: 120VAC, 50HZ~60HZ
- D. OPERATING TEMPERATURE: -25°C~+70°C
- E. COMMUNICATIONS: ETHERNET, CELLULAR, DIGITAL IO, WIFI
- F. DIGITAL INPUTS: 8 (OPTICALLY ISOLATED, 3~26VDC)
- G. RELAY OUTPUTS (SPDT/FORM A): 8 (2.5A, 125VAC, 30VDC)
- H. THERMOCOUPLES: 2 (INTERNAL AND EXTERNAL)

AUTOMATIC TRANSFER SWITCH:

MANUFACTURED UNITS:

- A. MANUFACTURER: THOMSON TS 870 SERIES
- B. QUANTITY: 1

SPECIFICATIONS:

- A. POLES: 3 POLE
- B. CONFIGURATION TYPE: ATS
- C. AMPERAGE: 1200 A
- D. OPERATION TYPE: OPEN TRANSITION
- E. SAFETY STANDARD: UL 1008 (NON - SERVICE ENTRANCE RATED)

- F. VOLTAGE: 277/480V
- G. CONTROLLER: TSC 900 C/W GHC GRAPHIC DISPLAY
- H. ENCLOSURE TYPE: NEMA 3R DD, ASA #61 GRAY – TS-H2
- I. UTILITY SWITCHING DEVICE: MOLDED CASE SWITCH C/W ELECTRONIC & GF TRIP (250-1200A)
- J. GENERATOR SWITCHING DEVICE: MOLDED CASE SWITCH (100-1200A)
- K. POWER CONNECTIONS: STANDARD
- L. ATS CONNECTION CONFIGURATION: STANDARD

GROUND AND ARC FAULT REDUCTION DEVICE:

MANUFACTURED UNITS:

- B. QUANTITY: 2

SPECIFICATIONS:

GENERAL FUNCTIONS

- A. DEVICE CAPABILITIES: COMBINED GROUND AND ARC FAULT DETECTOR AND INTERRUPTER/DISCONNECT FOR PV STRINGS
- B. MAX. VOLTAGE RATING PER INPUT: 1000V
- C. MAX. CURRENT RATING PER INPUT: 25A
- D. NUMBER OF INDIVIDUAL INPUTS: 4
- E. MAX. STRING INPUTS: 8
- F. COMMON GROUNDING: NEGATIVE TERMINAL, OPTIONALLY POSITIVE
- G. INTERFACES: MODBUS RTU RS485, UP TO 24V DIGITAL I/OS
- H. FAULT LATCH: YES
- I. DISCONNECT: YES
- J. RESET: YES
- K. FAULT/STATUS INDICATORS: YES

L. GROUND FAULT CURRENT TRIP LEVEL: CONFIGURABLE FROM 100MA
TO 1A

POWER SUPPLY

- A. INTERNAL ON BOARD: 1500V TO +24V
- B. EXTERNAL: +24V

INDICATORS

- A. POWER ON: RED LED
- B. CHANNEL STATUS (4): TWO COLOR LED. GREEN-CLOSED. RED-OPEN.

CONTROLS

- A. STOP: LOCAL E-STOP, GLOBAL E-STOP, MODBUS COMMAND
- B. RESET: LOCAL RESET, MODBUS COMMAND

STANDARDS & COMPLIANCE

- A. CERTIFICATIONS: UL1741 (GROUND FAULT), UL1699B (ARC FAULT)

ENVIRONMENTAL

- A. STORAGE TEMPERATURE: -40°C TO 60°C
- B. ENVIRONMENTAL RATING: NEMA 4 & IP66
- C. COOLING: CONVECTION
- D. HUMIDITY: 0-95%
- E. OPERATING AMBIENT TEMPERATURE: -5°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: 0.55M H X 0.42M W X 0.27M D
- B. WEIGHT: 20KG

PV STRING LEVEL DC-DC OPTIMIZER:

MANUFACTURED UNITS:

- A. MANUFACTURER: ALENCON SPOT 1000

B. QUANTITY: 2

SPECIFICATIONS:

INPUT

- A. MAX. NUMBER OF MPPTS/INPUTS PER SPT: 4
- B. MAX. STRING VOLTAGE: 1000V
- C. STRING OPERATING VOLTAGE: 200-1000V
- D. MPPT VOLTAGE RANGE: 200-880V
- E. MAX. CURRENT PER INPUT/DEVICE: 25A/100A
- F. REVERSE POLARITY PROTECTION: YES
- G. MAX. POWER PER INPUT/DEVICE @ 25°C: 22 KW/88 KW
- H. MAX. POWER PER INPUT/DEVICE @ 50°C: 16.94 KW/67.76 KW
- I. GROUNDING CONFIGURATION: POSITIVE, NEGATIVE OR FLOATING

OUTPUT

- A. OUTPUT OPERATING VOLTAGE: FULLY CONFIGURABLE FROM 200 TO 1500V
- B. MAX. NUMBER OF OUTPUTS: 4
- C. REVERSE POLARITY PROTECTION: YES
- D. GROUNDING CONFIGURATION: FLOATING

EFFICIENCY

- A. PEAK EFFICIENCY: 98.5%
- B. CEC WEIGHTED EFFICIENCY: 98%

STANDARDS & COMPLIANCE

- A. CERTIFICATIONS: UL1741, IEC 62109-1, CSA C22.2

ENVIRONMENTAL

- A. STORAGE TEMPERATURE: -40°C TO 85°C

- B. COOLING: NATURAL CONVECTION OR FORCED AIR
- C. ENVIRONMENTAL RATING: NEMA 3R & IP66
- D. HUMIDITY: 0-95%
- E. OPERATING AMBIENT TEMPERATURE: -40°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: RAIL MOUNT: 642MM X 416MM X 311MM / RACK MOUNT: 8U/353MM X 486MM X 637MM / (HEIGHT WITH FEED: 9U)
- B. WEIGHT: 54KG (WITH FEED: ADD 14 KG)

ADDITIONAL FEATURE

- A. COMMUNICATIONS – REQUIRED ACE: WIRED OR WIRELESS – MODBUS TCP PROTOCOL
- B. AFCI-REQUIRES GARD: UL1699B
- C. GFCI-REQUIRES GARD: UL1741

ISOLATION TRANSFORMER:

MANUFACTURED UNITS:

- A. MANUFACTURER: EATON / HAMMOND / SCHNEIDER / GE / SIEMENS
- B. QUANTITY: 1

SPECIFICATIONS:

- A. PRIMARY VOLTAGE: 480V DELTA
- B. SECONDARY VOLTAGE: 480 Y 277V
- C. CAPACITY: 300KVA
- D. TEMPERATURE RISE: 150° C
- E. INSULATION CLASS: 200°C

EFFICIENCY

- A. PEAK EFFICIENCY: PER DOE 2016 STANDARD 10 CFR PART 431

STANDARDS & COMPLIANCE

- A. CERTIFICATIONS: UL 1561

ENVIRONMENTAL

- A. ENCLOSURE RATING: NEMA 3R
- B. COOLING: NATURAL CONVECTION
- D. HUMIDITY: 0-95%
- E. OPERATING AMBIENT TEMPERATURE: -5°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: 52" X 37.5" X 34"
- B. WEIGHT: 1950LB

ADDITIONAL FEATURE

- A. HIGH EFFICIENCY ALUMINUM WINDINGS
- B. VACUUM PRESSURE IMPREGNATED WINDINGS
- C. PRIMARY ADJUSTMENT TAPS PROVIDED

AC COMBINER:

MANUFACTURED UNITS:

- A. MANUFACTURER: EATON / SCHNEIDER / GE / SIEMENS
- B. QUANTITY: 1

SPECIFICATIONS:

- A. VOLTAGE RATING: 480V DELTA
- B. CURRENT RATING: 400A
- C. OCPD: CIRCUIT BREAKER

STANDARDS & COMPLIANCE

CERTIFICATIONS: NEMA PB1

ENVIRONMENTAL

- A. ENCLOSURE RATING: NEMA 3R
- B. HUMIDITY: 0-95%
- C. OPERATING AMBIENT TEMPERATURE: -5°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: 36" X 36" X 12"
- B. WEIGHT: 200LB

ADDITIONAL FEATURE

- A. TIN PLATED ALUMINUM MAIN BUS BARS
- B. SYSTEM GROUND BUS
- C. FULL-SIZE INSULATED STAND-OFF NEUTRAL BARS

PV VISIBLE BLADE DISCONNECT SWITCH:

MANUFACTURED UNITS:

- A. MANUFACTURER: EATON / SCHNEIDER / GE / SIEMENS
- B. QUANTITY: 1

SPECIFICATIONS:

- A. VOLTAGE RATING: 480V DELTA
- B. CURRENT RATING: 600A

STANDARDS & COMPLIANCE

CERTIFICATIONS: NEMA KS-1

ENVIRONMENTAL

- A. ENCLOSURE RATING: NEMA 3R
- B. HUMIDITY: 0-95%
- C. OPERATING AMBIENT TEMPERATURE: -5°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: 36" X 52.7" X 16"
- B. WEIGHT: 200LB

ADDITIONAL FEATURE

- A. LOCKABLE
- B. SWITCH BLADES READILY VISIBLE IN THE 'ON' AND 'OFF' POSITION
- C. PAINT COLOR SHALL BE ANSI 61 GRAY

DC COMBINER:

MANUFACTURED UNITS:

- A. MANUFACTURER: SHOALS / SOLARBOS / OTHERS
- B. QUANTITY: 1

SPECIFICATIONS:

- A. VOLTAGE RATING: 1000V DELTA
- B. CURRENT RATING: 150A
- C. OCPD: FUSES

STANDARDS & COMPLIANCE

CERTIFICATIONS: UL 50

ENVIRONMENTAL

- A. ENCLOSURE RATING: NEMA 3R
- B. HUMIDITY: 0-95%
- C. OPERATING AMBIENT TEMPERATURE: -5°C TO 50°C

PHYSICAL CHARACTERISTICS

- A. SIZE: 36" X 72" X 16"
- B. WEIGHT: 400LB

ADDITIONAL FEATURE

- A. DISCONNECT SWITCH
- B. SYSTEM GROUND LUG

371.1 CENTRALIZED EMERGENCY LIGHTING INVERTERS - GENERAL REQUIREMENTS

- A. Provide complete centralized emergency lighting inverter system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Inverter Assemblies: Manufactured units consisting of inverters, batteries, enclosures, and associated components specifically designed for emergency lighting applications; microprocessor-based utilizing pulse width modulation (PWM) with insulated gate bipolar transistors (IGBT's); listed and labeled as complying with UL 924.
 - 1. Battery Run Times of 90 Minutes: Listed as complying with UL 924 for "emergency lighting and power equipment".
 - 2. Battery Run Times Other than 90 Minutes: Listed as complying with UL 924 for "auxiliary lighting and power equipment".
- D. Provide inverters and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Increase indicated power ratings as required to accommodate any applicable inverter load restrictions.
- F. Inverters Installed in Spaces Used for Environmental Air: Plenum rated; listed and labeled as complying with UL 2043, suitable for use in air-handling spaces.
- G. Battery System:
 - 1. Provide battery capacity as required for achieving battery run time indicated.
 - 2. Battery Charger: Microprocessor-controlled, temperature compensated; capable of returning supplied battery(s) from fully discharged to fully charged condition within time required by NFPA 111 and UL 924 unless otherwise indicated.
 - 3. Provide automatic low voltage battery disconnect to prevent battery "deep discharge" damage.
- H. Enclosures:
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Hinged Doors: Lockable, with all locks keyed alike.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.

- I. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category B.
- J. Automatic Sequence of Operations:
 - 1. Upon failure or degradation of primary/normal input power, transfer load to battery power.
 - 2. When primary/normal input power has been restored, retransfer load to primary/normal power and recharge battery.

PART 3 EXECUTION

372.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of inverter assemblies are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive inverter assemblies.
- E. Verify that conditions are satisfactory for installation prior to starting work.

372.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install assemblies in accordance with applicable requirements of NECA 416.
- C. Install products in accordance with manufacturer's instructions.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- G. Install assemblies plumb and level.
- H. Unless otherwise indicated, mount floor-mounted inverter assemblies on properly sized 3 inch high concrete pad constructed in accordance with Section 033000.
- I. Provide grounding and bonding in accordance with Section 260526.
- J. Identify inverter assemblies and associated system wiring in accordance with Section 260553.

372.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Notify Owner and Architect at least two weeks prior to scheduled inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank.
- F. Prepare and start system in accordance with manufacturer's instructions.
- G. Perform acceptance test in accordance with NFPA 111.
- H. Inspect and test in accordance with NETA ATS, except Section 4.
- I. Perform inspections and tests listed in NETA ATS, Section 7.22.2.
- J. Batteries and Charger: Perform inspections and tests listed in NETA ATS, Section 7.18.
- K. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- L. Submit detailed reports indicating inspection and testing results and corrective actions taken.

372.4 CLEANING

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

372.5 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of emergency lighting inverter system to Owner, and correct deficiencies or make adjustments as directed.

- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of emergency lighting inverter system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

372.6 PROTECTION

- A. Protect installed inverter assemblies from subsequent construction operations.

372.7 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of emergency lighting inverter system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 4 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION 263999

SECTION 264300 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

- A. Section 260526 - Grounding and Bonding for Electrical Systems.
- B. Section 262300 - Low-Voltage Switchgear.
- C. Section 262413 - Switchboards.
- D. Section 262416 - Panelboards.
- E. Section 262419 - Motor-Control Centers.
- F. Section 262513 - Low-Voltage Busways.

1.3 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1283 - Standard for Electromagnetic Interference Filters; Current Edition, Including All Revisions.
- F. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
 - 2. UL 1283 (for Type 2 SPDs).
- E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Factory-installed, Internally Mounted Surge Protective Devices:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- B. Substitutions: See Section 016000 - Product Requirements.
- C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.
 - 2. Outdoor locations: Type 3R.
- C. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
 - 1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.
 - 2. Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.
- D. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
- E. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
- F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.
- D. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- E. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
- F. Repetitive Surge Current Capacity: Not less than 3,500 impulses.
- G. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.5 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
- E. Repetitive Surge Current Capacity: Not less than 2,000 impulses.

- F. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 260526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 260526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.4 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 264300

SECTION 265100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Drivers.
- E. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 260529 - Hangers and Supports for Electrical Systems.
- B. Section 260533.16 - Boxes for Electrical Systems.
- C. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 260553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 260923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- F. Section 262726 - Wiring Devices: Manual wall switches and wall dimmers.
- G. Section 265600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).

- E. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- F. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- H. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- I. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- J. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts; 2011.
- K. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. NFPA 101 - Life Safety Code; 2015.
- N. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- O. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- P. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- Q. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
- D. Samples:
 - 1. Provide one sample(s) of each luminaire where indicated.
- E. Field quality control reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 - 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for LED luminaires, including drivers.
- C. Provide ten year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.

- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the source and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 - 2. White LED Tape:
 - a. Color Rendering Index (CRI): Not less than 90.
- J. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.
- K. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

- C. Battery:
 - 1. Sealed maintenance-free lead calcium unless otherwise indicated.
 - 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.
- H. Accessories:
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
 - 3. Provide compatible accessory wire guards where indicated.
 - 4. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.4 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as indicated or as required for the installed location.
 - 2. Directional Arrows: As indicated or as required for the installed location.

2.5 LED DRIVERS

- A. LED Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. LED Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- E. Provide required support and attachment in accordance with Section 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.

4. Secure pendant-mounted luminaires to building structure.
 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- I. Recessed Luminaires:
1. Install trims tight to mounting surface with no visible light leakage.
 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- J. Suspended Luminaires:
1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
- K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
 2. Install lock-on device on branch circuit breaker serving units.
- O. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from circuit indicated. Bypass local switches, contactors, or other lighting controls.
 2. Install lock-on device on branch circuit breaker serving units.
- P. Identify luminaires connected to emergency power system in accordance with Section 260553.
- Q. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting) and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100

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SECTION 265600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.
- B. Poles and accessories.
- C. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 260526 - Grounding and Bonding for Electrical Systems.
- C. Section 260529 - Hangers and Supports for Electrical Systems.
- D. Section 260533.16 - Boxes for Electrical Systems.
- E. Section 260548 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 260923 - Lighting Control Devices: Automatic controls for lighting including outdoor motion sensors, time switches, and outdoor photo controls.
- G. Section 262726 - Wiring Devices: Receptacles for installation in poles.
- H. Section 262813 - Fuses.
- I. Section 265100 - Interior Lighting.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals; 2013, with Editorial Revision (2022).
- C. ANSI C136.10 - American National Standard for Roadway and Area Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing; 2010.
- D. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).

- E. IEEE C2 - National Electrical Safety Code; 2012.
- F. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- G. IES LM-63 - IESNA Standard File Format for Electronic Transfer of Photometric Data and Related Information; 2002 (Reaffirmed 2008).
- H. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- I. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- K. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
- L. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- O. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- P. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:

1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
 3. Provide structural calculations for each pole proposed for substitution.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.
 3. Lamps: Include rated life and initial and mean lumen output.
 4. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.
- D. Sustainable Design Documentation: Submit manufacturer's product data on lamp mercury content and rated lamp life, showing compliance with specified requirements.
- E. Samples:
1. Provide one sample(s) of each specified luminaire where indicated.
- F. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.
- G. Field Quality Control Reports.
1. Include test report indicating measured illumination levels.
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- I. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 016000 - Product Requirements, for additional provisions.
 2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.

- 3. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
 - 4. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.
 - 5. Touch-Up Paint: 2 gallons, to match color of pole finish.
- K. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.

- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- I. LED Tape Lighting Systems: Provide all power supplies, drivers, cables, connectors, channels, covers, mounting accessories, and interfaces as necessary to complete installation.
 - 1. LED Tape - General Requirements:
 - a. Listed.
 - b. Designed for field cutting in accordance with listing.
 - c. Wet Location Applications: IEC 60529, IP 68 (waterproof) rated.
 - 2. White LED Tape:
 - a. Color Rendering Index (CRI): Not less than 90.
- J. Exposed Hardware: Stainless steel.

2.3 LED DRIVERS

- A. Ballasts/Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.4 POLES

A. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.
2. Structural Design Criteria:
 - a. Comply with AASHTO LTS.
 - b. Wind Load: Include effective projected area (EPA) of luminaire(s) and associated supports and accessories to be installed.
3. Material: Steel, unless otherwise indicated.
4. Shape: Square straight, unless otherwise indicated.
5. Finish: Match luminaire finish, unless otherwise indicated.
6. Mounting: Install on concrete foundation, height as indicated on the drawings, unless otherwise indicated.
7. Unless otherwise indicated, provide with the following features/accessories:
 - a. Top cap.
 - b. Anchor bolts with leveling nuts or leveling shims.
 - c. Anchor base cover.
 - d. Provision for pole-mounted weatherproof GFI receptacle where indicated.
 - e. Hinged base.

B. Metal Poles: Provide ground lug, accessible from handhole or transformer base.

2.5 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.

- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 260533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 260529.
- F. Provide required seismic controls in accordance with Section 260548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
 - 3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- I. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet in length, with no more than 4 feet between supports.
 - 4. Install canopies tight to mounting surface.
 - 5. Unless otherwise indicated, support pendants from swivel hangers.

- J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- K. Pole-Mounted Luminaires:
 - 1. Maintain the following minimum clearances:
 - a. Comply with IEEE C2.
 - b. Comply with utility company requirements.
 - 2. Foundation-Mounted Poles:
 - a. Provide cast-in-place concrete foundations for poles as indicated, in accordance with Section 033000.
 - 1) Install anchor bolts plumb per template furnished by pole manufacturer.
 - 2) Position conduits to enter pole shaft.
 - b. Install foundations plumb.
 - c. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.
 - d. Tighten anchor bolt nuts to manufacturer's recommended torque.
 - e. Install non-shrink grout between pole anchor base and concrete foundation, leaving small channel for condensation drainage.
 - f. Install anchor base covers or anchor bolt covers as indicated.
 - 3. Embedded Poles: Install poles plumb as indicated.
 - 4. Grounding:
 - a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.
 - b. Provide supplementary ground rod electrode as specified in Section 260526 at each pole bonded to grounding system as indicated.
 - 5. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.
 - 6. Install non-breakaway in-line fuse holders and fuses complying with Section 262813 in pole handhole or transformer base for each ungrounded conductor.
 - 7. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 262726 in designated poles.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.

- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.
- E. Measure illumination levels at night with calibrated meters to verify conformance with performance requirements. Record test results in written report to be included with submittals.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

3.9 ATTACHMENTS

- A. Luminaire schedule.
- B. Luminaire cut sheets.

END OF SECTION 265600

DIVISION 27

COMMUNICATIONS

SECTION 27 10 00 – STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. This section shall define the Moorpark City Library (hereinafter referred to as Owner), Access Control and Alarm Monitoring system (ACAMS) system design standards and installation criteria.

1.2 RELATED WORK NOT IN THIS SECTION

- A. General and specific provisions of these standards apply to the work detailed in this Section, as well as:
 - 1. Electrical (Division 26)
 - 2. Digital Video Management System (Section 28 30 00)

1.3 DESCRIPTION

- A. Furnish, install, and test a complete and functional communications infrastructure system to provide voice, and datacommunications.
- B. J-hooks, boxes, and supporting hardware needed for pathway systems.
- C. Furnish and install station cabling, faceplates, and jacks for connectivity of voice/data systems and other IP devices.
- D. Furnish and install all racks, equipment grounding to bus bars, and other hardware needed to fully configure the MDF/IT Server Rm./Radio Rm., and Telecommunications Cross connects / IDFs in this Section and shown on the Drawings.
- E. Completely label and test all telecommunication cables, provide test documentation, and as-built drawings..
- F. Furnish and install new 24s OS2 Single mode fiber from the new Library MDF to the City of Moorpark Community Center Video Room via underground conduit infrastructure shown on drawings.

1.4 SUBMITTAL

- A. Prior to ordering any material, provide six (6) copies of complete brochure information on all products for installation on this project. All brochures and specification sheets shall be bound within a three-ring loose leaf binder and organized in the same manner as the products portion of the specifications. If more than one product is listed on the same page of the brochure or specification sheet submitted, the intended product or part

number shall be clearly indicated or highlighted by the Contractor.

- B. Contractor shall submit along with the materials submittal all Proposed Test Procedures and a sample of the printout or test result form as well as a list of all Test Equipment to be used for cable testing. Within two (2) weeks of completion of testing all cabling systems, Contractor shall submit two (2) copies of the test results as directed in the Testing portion of the Specifications.
- C. Contractor to submit pre-construction commissioning checklist for manufacturer's startup and testing.
- D. Contractor to provide proposed test procedure for review / approval not later than by 2-weeks prior to testing.

1.5 QUALITY ASSURANCE

- A. Standards: The contractor will furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications.
 - 1. The cable system shall meet the standards set forth in the American National Standards Institute / Electric Industries Association / Telecommunications Industry Association recommended standards EIA/TIA-568-B, -569, -607, and EIA/TIA-TSB 67, 72; EIA/TIA Technical Specification Bulletin 40 for Category 6 wire specifications.
 - 2. All cable installed under this specification shall be Underwriters' Laboratories (UL) listed and certified to pass the appropriate UL test for cable designated for installation in plenum and riserspaces.
- B. The telecommunication cable system shall conform to all applicable local codes and applicable sections of the National Electric Code, NFPA-70-2010.
- C. Fire stopping shall be in accordance with ASTM E 814, ASTM E 136, and UL 1479 as well as Section 300-21 of the National Electric Code.
- D. Other applicable standards. ANSI C2-2010 National Electric Safety Code. UL 497 Electrical Grounding and Bonding Equipment.
 - 1. IEEE 802.3 Carrier Sense Multiple Access With Collision Detection.
 - 2. FCC Rules and Regulations, Part 68.
 - 3. Basic, Uniform, and Standard Building Codes (BOCA, ICBO, SSBC).
 - 4. REA Cable Designations - PE Series Specifications
 - 5. NFPA 101 - Life Safety Code
- E. Conditions: Materials and equipment provided must be new products of manufacturers regularly engaged in the production of such products.
- F. UL Listing: Products must be UL listed where a UL test procedure is applicable.
- G. Telephone system materials and equipment shall be FCC Type-accepted and certified as

such by supplier.

- H. Qualifications: The category 6A and fiber cable system required for this project is a Leviton/Berk-Tek structured wiring system. The contractor must be a Leviton Certified Cable System Contractor with a minimum "Leviton Installation Partner (LIP)" status, from the Sacramento, Ca. region as specified by Leviton Corporation. The "LIP" certification must be in place 45 days prior to bid. The company must have a minimum of three (3) years of experience in low voltage installations for voice, and data cabling systems. All personnel performing work on this project must have gone through the Leviton LIP training program as required by Leviton prior to performance of work.
- I. Warranty: Contractor shall provide a Lifetime Manufacturer's warranty covering workmanship and compliance with manufacturer's specifications for category 6, & Indoor Fiber cable systems. All repair, including labor and material, shall be made at no cost to City of Moorpark during the warranty period. All warranties shall be provided in writing to City of Moorpark prior to acceptance of the cabling system.
- J. Contractor shall have the manufacturer's representative provide periodic inspections of the cable system during the installation phase. Inspections will occur:
 - 1. After termination of jacks and before wall plates are installed.
 - 2. After termination of Patch Panels.
 - 3. After termination of fiber cable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials in manufacturer's standard protective packaging.
- B. Do not remove protective packaging until ready for installation.
- C. Follow manufacturer's instructions for storage & handling.

1.7 CONTRACT DRAWINGS AND SPECIFICATIONS

- A. The intent of the drawings and specifications is to establish the type of system and functions, but not to set forth each item essential to the functioning of the system. The drawings are generally diagrammatic and show approximate location and extent of work. In case of doubt of work intended, it is the responsibility of the Contractor to request instructions from the Engineer or Owner prior to bid. The Contractor shall be responsible for installing a complete functioning system.
- B. Contractor shall review all drawings and specifications before starting the work. Where discrepancies occur, Contractor shall immediately notify Engineer for clarification.

1.8 RECORD DRAWINGS

- A. All drawings shall be submitted in hard copy with all field changes and contractor labeling indicated in red line updates. Upon completion of the project, Contractor shall

deliver to Owner documentation of the project to include:

1. As-built telecommunications floor plans of the facility with cable, outlet placement and full labels clearly depicted.
 2. As-built elevations of all termination fields describing cable and outlet location labeling scheme, and any changes to the wall elevations and conduit placements in the IT rooms will be recorded on as-built drawings
 3. As-built logical riser diagram describing connectivity and cable sizes, for copper, fiber and grounding cabling systems. Diagram shall include as-built labeling of all OSP and rise cables.
- B. Cable test results shall be submitted in hard copy and magnetic format along with viewing software from the tester manufacturer. Hard copy to be bound within loose leaf binder and organized by serving MDF or IDF, room number of outlet location, and station identifier.

PART 2 - PRODUCTS

2.1 HORIZONTAL STATION CABLES

- A. Category 6A Twisted Pair Voice and Data Cable
1. Conductors-24 AWG solid bare annealed copper.
 2. Insulation-Riser
 3. Pairing-Varying pair lays
 4. Color Code-Standard Blue, Orange, Green, & Brown Pairings
 5. Jacket-Riser Sequential footagemarkers
 6. Compliances:
 - a. ISO/IEC 11801
 - b. ANSI/TIA/EIA 568-B.2 (July2002)
 - c. UL Listed Type MPP/CMP,MPR/CMR
 7. Category 6A cables shall have a white cable jacket for all outlets.
 8. Acceptable Manufacturers: Category 6A, Superior Essex NextGain #:
 - a. Data Cable (white) 11142398.
 - b. Security (Yellow) 11143101
 - c. Other Bldg. Systems (Green) 11143102

2.2 FIBER OPTIC CABLES

- A. OSP Fiber Optic Backbone Cabling
1. The approved fiber optic cable shall have the following features:
 - a. Cable shall be indoor/outdoor rated jacket.
 - b. Cable shall be constructed using a Tight Buffer design
 - c. Cable will maintain the following:
 - 1) Compliance: TIA/EIA-568-C.3 and ICEA S-87-Functional Requirements: GR-

- 20-CORE and GR-409-
- 2) Min Bend Radius:
 - 3) Long Term - No Load = 10x Cable diameter
 - 4) Short Term - Load = 15x Cable diameter
 - 5) Operating Temp. = -0°C to +70°C
 - 6) Storage Temp. = -40°C to +70°C
2. The site fiber shall be a Singlemode OS2, 8/125, 48 strand loose tube, all dielectric, OSP cable.
 3. All OSP fiber shall be loose tube, all dielectric, outdoor cable.
 4. The fiber cable must comply with the following minimum transmission parameters:

<u>Max Attenuation</u>		<u>Bandwidth</u>	
Multimode OM4 (50/125 10G/150)			
850 nm	1300 nm	850 nm	1300 nm
3.5 dB/km	1.5 dB/km	220 MHZ km	600 MHZ km

<u>Max Attenuation</u>		<u>Bandwidth</u>	
Singlemode (Reduced Water Peak)			
1310 nm	1550 nm	1310 nm	1550 nm
.4 dB/km	.3 dB/km	220 MHZ km	600 MHZ km

5. All multimode and Singlemode fiber shall be terminated with LC fiber connectors and placed in separate patchpanels.
 - a. Cable shall be constructed of 50/125μ OM4 Multimode Laser Optimized rated glass and 9/125μ OM2 single mode glass.
 - b. The site fiber shall be a Singlemode 8/125, 48 strand loose tube, all dielectric, OSP cable.
 - c. All OSP fiber shall be loose tube, all dielectric, outdoor cable.
6. All multimode and Singlemode fiber shall be terminated with LC fiber connectors and placed in separate patchpanels.
7. Acceptable Fiber Termination patch panels are
 - a. Leviton: #5R730 w/LC Mounting Plates #
 - b. Leviton: #5P330-0AB. Use Zirconia Ceramic Sleeves.
8. Acceptable Manufacturers of fiber cable are Superior Essex:
 - a. Multimode OSP #120126D0P
 - b. Singlemode OSP #120123D8

2.3 PATCH CABLES & TERMINATION HARDWARE

A. Data Patch Cables

1. Factory assembled and tested 8 position / 8 conductor (8P/8C) UL-rated Category 6A 4-pair copper patch cords shall be provided by the Contractor. Quantity of patch cables shall be determined from data jack tabulations shown on the drawings.

Sufficient quantities of patch cables shall be provided to allow the Owner:

- a. To activate the number of data terminals at each station location shown on the drawings, and
 - b. To provide patching between each patch panel port to be activated at move-in and the network equipment.
- B. Work station patch cables shall be provided in one length such that the cables can be routed from data outlet to workstation device with sufficient slack for moderate workstation device movement.
- C. IDF patch cables shall be provided in various lengths, such that the cables can be routed within the cable management hardware without crossing any other patch panel unnecessarily and to allow easy connection at each end, with minimal additional cable requiring storage within the cable management hardware.
1. Patch/Interconnect cables shall be as follows:
 - a. Blue – workstation patch cords – 10'
 - b. Blue – TC patch cords – 5' & 7'
 2. Patch cords shall be rated category 6+ as manufactured by Leviton Extreme 6 products.
 - a. IDF Patch Cord, 5 ft.: Part # 62460-05L – Provide quantity to match 50% of the Data cables installed (example: 100 cables installed, 50 patch cables provided).
 - b. IDF Patch Cord, 7 ft.: Part # 62460-07L – Provide quantity to match 50% of the Data cables installed (example: 100 cables installed, 50 patch cables provided).
 - c. Station Patch Cord, 10 ft.: Part # 62460-10L – Provide quantity to match 100% of the Data cables installed (example: 100 cables installed, 100 patch cables provided).
- D. Grounding Conductors
1. Bare stranded copper ground conductors shall be provided and installed by the Contractor as shown on the project drawings to provide a grounding system consistent with the 2002 National Electric Code as well as EIA/TIA 607.
 2. Ground conductors shall be minimum 0 AWG between TC Closets, and the Building Service Ground point and minimum 6 AWG between hardware components located within the MDF & IDF closets.
 3. All cable runway shall be bonded together, and bonded to the ground bus bar.
 4. Each equipment rack shall be bonded independently to the ground bus bar.
 5. Each connection to cable runway, and equipment racks shall be to bare metal. Paint shall be scraped away, exposing bare metal.
 6. Ground Lugs shall utilize 2 screw holes to hold lug in place.
- E. Copper Patch Panels
1. Work Station: Equipment rack-mounted 48-port, patch panels shall be provided and installed as indicated on the accompanying project plans. Patch panels shall be rated Category 6 compliant (per EIA/TIA TSB-40) and shall utilize 8P/8C style non-keyed jacks with T568B pinout assignments and 110 style termination.
 - a. Acceptable Manufacturers: Leviton Extreme 6+ #69586-U48

2. Telephone Panels: Equipment rack-mounted 48-port patch panels shall be provided and installed as indicated on the accompanying project plans. Patch panels shall be rated Category 5e compliant (per EIA/TIA 568) and shall utilize 8P/8C style non-keyed jacks with T568B pinout assignments and 110 style termination.
 - a. Acceptable Manufacturers: Leviton#5G596-C48

F. 110-Style Termination/Wiring and Connecting Blocks

1. 110 Style termination/wiring blocks for cross connecting between voice station and riser cables shall be provided and installed as shown on the project plans.
 - a. 110 blocks shall be wall-mountable and manufactured with standoff legs to allow cables to pass behind. All required connecting blocks (4-pair and 5-pair), and labeling strips shall be included.
2. Connecting Blocks shall be Category 6 for all voice station cable installed.
3. Connecting Blocks shall be C-5 for all riser cable installed.
4. Acceptable Manufacturers: Cross-connects and wall terminations blocks will be:
 - a. Leviton
 - b. Station:110blocks, 100 pair-#41AB6-1F4
 - c. Station:C-4 Connectingblocks-#69104-IDC
 - d. Riser:110 blocks, 300pair-#41AW2-100.
 - e. Riser Cat 5 Connectingblocks-#49105-IDC

2.4 FIBER OPTIC TERMINATION HARDWARE

A. Fiber Termination Shelves, Singlemode and Multimode

1. Fiber shelves shall provide for current and future fiber. Outside singlemode fiber shall be fusion spliced to pre-terminated fiber pigtails. Riser tight buffered fiber shall be direct connected with SC connectors.
2. Manufacturer: Leviton Corporation
3. Singlemode Fiber Hardware, (Includes Termination Shelf, Adapter Plates, Splice Trays, SC Pigtails, Cable Clamp and Mounting Ears)
 - a. 2U fiber panel (OSP fiber cable)
 - b. Part #2OPTX-02AJD01NY19N
4. Multimode Fiber Hardware, (Includes Termination Shelf, Adapter Plates, Cable clamp and Mounting Ears)
 - a. 1U fiber panel (Riser fiber cable)
 - b. Part #1OPTX-02BBNNCY19N

B. Fiber Connectors, Multimode SC, Field Installed

1. Manufacturer: Leviton
2. SC Fast Cure Connector #49990-MS (Beige)

2.5 TELECOMMUNICATIONS WORKSTATION OUTLETS

- A. Universal Data outlets will be of modular design. Each outlet shall be configured with

Modular 8-Pin jacks wired to the T568B pin assignment sequence.

- B. All outlet jacks will be rated for category 6A systems. All jacks will be White.
- C. Acceptable Manufacturers: Leviton Extreme 6A jack #6110G-RW6
- D. All AP outlet jacks will be rated for category 6A systems. AP jacks will be Green.
- E. Acceptable Manufacturers: Leviton Extreme 6A jack #6110G-RG6.
- F. All Security outlet jacks will be rated for category 6A systems. AP jacks will be Yellow.
- G. Acceptable Manufacturers: Leviton Extreme 6A jack #6110G-RY6.
- H. All single gang wall plates will have ID windows, match the color of the electrical cover plates and have a minimum of 4 ports. Leviton #42080-XXX
- I. All wall phone outlets shall be recessed stainless steel single gang plates.
 - 1. Leviton #4108W-1SP

2.6 CABLE SUPPORT HARDWARE AND MISCELLANEOUS MOUNTING EQUIPMENT

- A. Miscellaneous Equipment shall be provided and installed by the Contractor as described below and on the drawings. Mounting hardware and accessories typically required to provide a complete and working installation but not listed in these specifications shall be provided and installed by the Contractor.
- B. Backboard Cable Management shall be provided and placed by Contractor on all telecommunications backboards to provide effective routing of all telecommunications cabling. Contractor shall utilize D-rings, wire distribution spools, and cable clamps as required for a neat and organized installation.
- C. J-hook Assemblies: Contractor is responsible for maintaining the maximum fill guidelines and spacing requirements as shown on the accompanying project plans. Contractor shall provide and install additional J-hook assemblies as required to meet these requirements.
 - 1. J-hook horizontal cable supporting hardware shall be UL listed. The J-hook(s) shall provide a broad base for proper cable support, thereby reducing stress and bending of cabling.
 - a. Contractor shall attach appropriate J-hook fasteners for wall, stud, beam, or flange mounting to the supporting structure. Fasteners shall be spaced a maximum of 5' apart, and no more than 4' from the final outlet destination or turn point as shown on the accompanying project drawings.
 - b. Acceptable Product: Caddy CableCat Clips, B-Line and required supporting hardware, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Contractor shall give notice to all agencies requiring advance notification and comply with all regulations specified by all governing agencies having jurisdiction over the performance of the work.
- B. Contractor shall coordinate with and abide by the construction schedule and sequencing as dictated by the General Contractor on the project. Storage and staging areas within the job site shall be as dictated by the General Contractor.
- C. The owner shall provide and pay all permits.
- D. The contractor shall provide all labor, materials, equipment, tools, utilities and services necessary for the proper execution and completion of the telecommunications cabling system.

3.2 INSTALLATION METHODS

- A. Contractor is required to adhere to the following parameters whether or not Contractor and/or others have placed existing equipment. Contractor will notify the owner of any of the following requirements that cannot be met prior to bid or ordering of materials.
- B. General: Install an infrastructure cabling system as detailed by the contract drawings, details, and specifications.
- C. The maximum length of horizontal cabling from nearest closet to an outlet shall not exceed 295 feet as per EIA/TIA 568. Contractor will notify The owner prior to commencement of any installation not meeting the 295-foot maximum distance limitation.
- D. Contractor will place all station cables in the ceiling area on Contractor supplied and installed wire hangers or in floor spaces and raceways. Contractor also will assess whether or not the ceiling space is a plenum air return, which shall dictate the use of the listed plenum type, or PVC type cable required in the materials specification section. The cables will be routed to the TC located on the first floor, utilizing cable tray. Station cables must be strapped every 5 feet with tie straps in J-Hooks provided by the Contractor; strapping to any other wires (e.g., lighting, ceiling grid, etc.) is not permitted. Cable splicing at any point of a station cable is unacceptable. When cables are routed in non-ceiling spaces, such as below raised flooring, the Contractor will still assess whether or not the space is a plenum air return and pull the appropriate cable type.
- E. In hard wall (wallboard) or V wall type construction where accessible, Contractor will install a wall board adapter or equivalent, which will support mounting of the faceplate necessary for the jacks. This will eliminate the need for an electrical box (in-wall junction box) to accommodate the communications outlet.
- F. Cables will be run vertically in dedicated EMT conduit inside the wall and into the ceiling space. Once in the ceiling space, the cable will be routed to the closest cable tray. Cables

shall be routed to their closest TC utilizing the shortest path possible, while still following EIA/TIA standard guidelines. Station cables outside of cable tray must be strapped to tie wires with J-Hooks every 5 feet provided by Contractor; strapping to any other wires (e.g., lighting, ceiling grid, etc.) is not permitted.

- G. In areas where modular furniture is installed or in areas where office furniture is in an open office space, telecommunications cabling access will either be through the floor or from the ceiling.
- H. Where the cable access is from a duct under the floor, the Contractor will provide and install mounting hardware inside the floor box that will support the outlets.
- I. The Contractor will provide and install a plastic spiral wrap device or metal flexible conduit to the cable channel in the furniture or to a surface mount box located at each work station. The Contractor shall coordinate with the owner, the exact location of each cable termination and jack location.
- J. UTP cabling must conform to a 6-foot separation requirement from main power panels, switch gear and/or starter motors.
- K. All power feeds crossing the path of the UTP cables at right angles must be a minimum of 6 inches in distance from the UTP cables.
- L. Cables shall be run cable tray in corridors wherever possible in order to avoid furniture and work areas so that access to the cables is unencumbered.
- M. The cables shall be placed at a minimum of 6 inches above the ceiling.
- N. The cables are to be run so as to maximize accessibility. Contractor will notify the owner in the event this requirement cannot be met.
- O. Debris, boxes, leftover cables, and trash must be removed from construction sites upon completion of work. No debris or work material may be left in areas that have student access unless the affected area is marked with cones, tape, or temporary fencing.
- P. Contractor shall pull conductors together where more than one is being installed in a raceway. Cable bundles in raceways, in suspension systems, or on wallboards must be tie wrapped every 5 feet. There must be an independent system supporting the cable system. Cable bundles tied to the lighting-ceiling grid will not be permitted. Station wire cannot be attached to electrical conduit, gas or sprinkler piping, or other code-restricted items.
- Q. No cabling is allowed to rest on any ceiling tile or suspension system. Cable shall be kept 30 inches away from any heat source; i.e., steam valves, etc.
- R. Cables shall be pulled free of sharp bends or kinks, twists, or impact damage to the sheath.
- S. Cables shall not be pulled across sharp edges. Cables shall not be forced or jammed

- between metal parts, assemblies, etc.
- T. Cables shall not be pulled across access doors and pull box covers. Access to all equipment and systems must be maintained.
 - U. Cables shall be protected from paint and any other chemicals during installation. Any paint or chemicals that adhere to the installed cable shall be cleaned from the cable per manufacturers requirements.. The cable manufacturer and the design consultant shall be notified.
 - V. Insulation shall be removed to expose shielding and conductors to the exact length required by manufacturer for proper termination of plugs and pins. Plugs and pins, upon termination, shall not be damaged in any way.
 - W. All communications racks must be properly anchored to walls and floors and grounded to building ground grid (not to water pipes, etc.).
 - X. Cable splicing will not be permitted in any horizontal cable run.
 - Y. Contractor shall install system using tools and equipment specifically designed for the installation tasks. Use installation practices that ensure the highest quality installation. Perform all cutting, splicing, pulling and termination of cables using equipment specifically designed for each purpose.
 - Z. Install tie wraps using a tension controlling cutting device. Tension shall not exceed that which is specified by the manufacturer of the cable. Tie wraps and other securing hardware shall be rated as required for the installation environment.
 - AA. Where multiple conduits are being used, fill one conduit to its maximum fill ratio before going onto the next conduit. Wherever possible, leave as many spare conduits available as possible.
 - BB. All cables requiring lubrication for installation in conduits shall be continuously lubricated during the pulling-in process. Maximum pulling tensions specified by the cable manufacturer shall not be exceeded. Monitor cable-pulling tension with a mechanical tension-indicator.
 - CC. CC.All new conduit will not exceed a 40% fill rate. All spare conduits or conduits filled with less than the maximum allowed fill ratio shall have a pull string installed and left for future installation of cable. Clearly label as "pulling line" indicating To/From.
 - DD. DD.Support cables running overhead that are not installed in raceways by bridle rings or J-Hooks spaced every 5 feet.
 - EE. Install the telecommunication cabling system as detailed in the contract drawings in the exact location and layout shown in the details.
 - FF. Openings around electrical raceway penetrations shall maintain the fire resistance rating required. See NEC 300-21.

1. GG. Label all cables at both ends. The label shall be permanent. Labels shall be typed (not handwritten) and individual number strips are unacceptable. An acceptable labeling product is a self-laminating cable marker, such as Brady #DAT-9-292-series. All cable labeling shall include numeric designation, source, destination, and cable type.
2. HH. All outlet plates shall be installed neatly and square with floor and walls.
3. II. Category 6 installations shall conform strictly with EIA/TIA 568B and TSB-40B to insure a quality system that meets the transmission rate criteria.

3.3 FIBER OPTIC CABLE SYSTEM

- A. The fiber optic raceway system must be continuous between pull boxes and junction boxes. The raceway system must enter and be secured to enclosures.
- B. All fiber supplied to the campus, must be tested with an OTDR, Microtest Certifiber, or equal prior to installation, while still on the shipping reel, using an optical time domain reflectometer (OTDR) or a 850/1300/1510 nm power meter and stabilized light source. The test results must be compared to the manufacturer's test results. A discrepancy of more than 1 dB on any fiber in either window indicates possible shipping damage and the fiber must be returned to the supplier.
- C. All fiber must be tested after installation according to the procedures and acceptability criteria described in EIA/TIA 455A (Aug 1991) and all applicable addenda after installation and termination using an OTDR in one direction and an 850/1300 nm power meter and stabilized light source in both directions and in both optical windows. The results of these tests (printed OTDR results and tabular loss results) must be provided by the installer as documentation of the quality of installation and as a baseline for future troubleshooting. The results must be compared to the pre- installation test results for significant changes.
- D. All optical test equipment must have current, traceable calibration certification.
- E. All spare optical ports and connectors should have a dust cap in place to protect the cable from the environment.
- F. Manufacturer's specification for pulling stress and minimum bend radius must not be exceeded on any fiber cable.
- G. Installation contractor must develop and review conduit installation plan with the owner before beginning installation.
- H. Installation contractor must verify all device locations with the owner before installation.
- I. Installation contractor must review cable numbering and labeling scheme with the owner prior to installation.
- J. Installation contractor must review drawing notes and drawing back-annotations (red

line) on site plans with the owner prior to installation.

- K. Fiber Optics Cable Labeling: Fiber termination locations must be labeled to corresponding fiber strands pairs at the Main Cross-connect (MC), Intermediate Cross-connect (IC), and the Telecommunications closet (TC). Use embossed labels. The Contractor is expected to provide tags, straps, and adhesive labels. These tags, straps, and adhesive labels must be of high quality that will endure over time. Hand written labels are not acceptable.
- L. All outside fiber cable will be installed through 1.25" innerduct from point of origin and destination.
- M. Securely fasten the fiber optics raceway to the cable tray, or walls when routed inside buildings, using clamps and clips designed for this purpose.
- N. Provide a nylon or polyethylene pulling line in all fiber optics raceways. Clearly label as "pulling line", indicating source and destination.
- O. Openings around fiber optics raceway penetrations shall maintain the fire resistance rating required. See NEC 300-21.
- P. All fiber optics cables are to be run as efficiently as possible, minimizing the amount of cable required.
- Q. All fiber optics cables shall be continuously lubricated during the pulling-in process. The maximum pulling tensions specified by the cable manufacturers shall not be exceeded. Monitor cable pulling tension with a mechanical tension meter.
- R. The fiber optics cables passing through pullboxes and manholes shall be neatly arranged and secured to cable jacks on the interior walls. Cables will not be accepted when diving through the manhole or pullbox.
- S. As fiber optics cables emerge from intermediate-point pull boxes, coil the cable in a figure eight pattern with loops not less than two feet in diameter.
- T. Label all fiber optic cables at both ends. The label shall be permanent. Labels shall be typed (not handwritten) and individual number strips are unacceptable. All cable labeling shall include numeric designation, source, destination, and cable type.
- U. Fiber optics raceways shall be clearly marked at each pull box indicating type and number of cables within.
- V. If connectors have been factory installed on fiber optic cables, protect the connector during the pulling-in by wrapping with a thin layer of foam and insert in a stiff plastic sleeve for protection.

3.4 OUTSIDE PLANT INSTALLATION

- A. The following specifications will be adhered to when splicing copper cable runs. These

specifications and standards apply for all splicing situations, including:

1. Manhole Splices and Splice Cases
 2. NEMA Enclosure Splices and Splice Cases
 3. MC/IC Splices and Splice Cases
 4. MC/IC Electrical Protection Splices
- B. The Contractor will splice all the cable pairs within each cable sheath using AT&T 710-SC1-25 Splice Modules, including cable pairs that will not be connected at this time. All splices shall be secured in a splice case using a preformed splice case. All splices and the installation of the splice case shall be in accordance with the manufacturer's specifications and GTE Practice, Section 632, ensuring a watertight seal. The Contractor will bond the cable's metallic sheath/shield to the metallic splice case with the bonding bar assembly provided with the splice case. No filling compound is to be used in the splice enclosures; therefore the Contractor must take special care while assembling the case.
- C. All copper cables passing through a manhole or pullbox will be dressed neatly to the inside walls with "L" brackets designed for securing cable in manholes and pullbox's. Cable that is not secured and routed properly will be removed and redone at no expense to the owner.

3.5 GROUNDING

- A. Grounding shall be accomplished by common single-point termination of all ground conductors.
- B. All metallic components of the infrastructure system shall be solidly grounded by the shortest possible route.
- C. Manhole Splices and Splice Cases - the Contractor will connect the splice case to the manhole ground as per GTE practice 605-100-201 using a #6 AWG solid copper wire.
- D. NEMA Enclosure splices and Splice Cases - the splice case must be grounded to the provided ground lug in the existing NEMA box with a minimum #6 AWG wire.
- E. MC/IC Splices and Splice Cases - the splice case must be grounded to the provided ground bar in the Voice/Data Equipment Room with a minimum #6 AWG wire.
- F. MC/IC Electrical Protection Splices - the Contractor must bond the cable's metallic sheath/shield to the metallic splice case with the bonding bar assembly provided with the splice case.
- G. Labeling: The splice case and all cables must be labeled using a stamped metal plate or indelible plastic plate, that The owner has approved, which details exact pair counts and destinations. Each 25-pair binder group, of each cable entering the splice case, must be labeled with a Panduit PAN-TY PLF1M-0 Flag with appropriate cable pair counts.
- H. Conduit Sealing: The Contractor will supply and install all necessary components to

effectively seal all conduits. The Contractor will use Semco part #PR-851 conduit sealing kit. The PR-851 compound is a two part polyurethane foam, which, when mixed for fifteen seconds, expands approximately fifteen times in volume. It forms a dense, tough foam with a density of three to four pounds per cubic foot. The expanding nature of the compound allows it to fill cracks and voids in conduit walls, and imperfections in the cable sheath. This effectively seals the conduit against the passages of gases and water. For additional information, refer to GTE Practice 628- 020-203.

3.6 FIRE STOPPING

- A. Clean surfaces to be in contact with fire stopping materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting or the required fire resistance.
- B. Install fire stopping materials as indicated, in accordance with manufacturers instructions.
- C. Seal all holes or voids made by penetrations to ensure an effective smoke barrier.
- D. Unless protected from possible loading or traffic, install fire stopping materials in floors having void openings of 4 square inches or more to support the same floor load requirements.
- E. A small amount of hydrogen gas is released as foam cures. Use forced air ventilation when installing if areas of installation have less than 2 cubic feet of free air for each pound of liquid mixture being foamed.
- F. Examine fire stopped areas to ensure proper installation prior to concealing or enclosing fire stopped areas.
- G. Areas of work shall remain accessible until inspection (and approval) by the applicable code authorities.

3.7 CABLE LABELING

- A. Refer to Attachment "A" for all labeling standards.
- B. All cables shall be labeled, using the owners cable identification standard.
- C. Intrabuilding Cable: All Intrabuilding cables will be labeled. Provide legible and indelible marking on all cables as indicated in the Drawings. Contractor shall ensure labeling of the cables during installation.
- D. Raceways shall be clearly marked at each pull box indicating type and number of cables within.

3.8 SYSTEM TESTING

- A. The Contractor shall be responsible for separately testing and documenting the cables and termination throughout the entire cabling system. Ensure that the cable and equipment being installed in the system is without flaw and that no potential damage to the cable or equipment occurred in shipment, handling, or installation. The owner representative shall observe the testing of the installed cabling and terminations at any time during the testing process
- B. Testing of all installed unshielded twisted pair telecommunications cabling shall be performed by the Contractor. Interim testing of the cabling system during and after installation is encouraged to ensure that the testing and acceptance criteria are met.
- C. Acceptance of the Telecommunications Cabling System shall be based on the quality of Contractor performance by analysis/inspection of the testing program documentation and the conformance of the system operation with the criteria described herein. Contractor shall make available all drawings and documentation prior to acceptance testing.
- D. Contractor shall provide all necessary testing equipment for performing the required acceptance test. Contractor shall verify the authenticity and display appropriate calibration data to include the expiration date of the correct calibration.
- E. Testing methods are provided herein as reference for the Contractor. Test equipment, methods, and criteria shall comply with the guidelines set forth in EIA/TIA TSB - 67 - Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems where applicable.
- F. Copper Cable Testing:
 - 1. Contractor shall perform final testing on the copper cable system to demonstrate the acceptability of the project as installed. Contractor shall perform and furnish documentation of the following tests:
 - a. Continuity of all conductors.
 - b. Shorted conductors or pairs.
 - c. Crossed pairs.
 - d. Grounded conductors.
 - e. Open conductors.
 - f. Reversed pairs.
 - g. Split pairs.
 - h. NEXT performance.
 - i. Length.
 - j. Attenuation.
 - k. AC voltage presence.
 - l. Pin-assignment confirmation
 - 2. Results of the testing shall be furnished in printed format. All test documents shall be dated and signed by the personnel performing the testing. Hand-written test results are not acceptable. Test gear used for general testing shall be Tektronix TPS 100 Twisted Pair Cable Analyzer or approved similar device.

3. All Category 6 wiring shall be tested to indicate a minimum of 350 Mbps transmission capability. Test results shall document each installed cable pair for
 - a. measured attenuation and Near End Cross Talk (NEXT). Category 6 testing shall utilize a Fluke 4000 Category 6 Scanner or approved similar device for performance validation. Category 6 End to End Link Performance shall be in accordance with the specification set forth in ANSI/TIA/EIA-568-A as well as meeting the documents' requirements for cabling length and topology, component performance and reliability, and installation practices.
4. Contractor shall be responsible for recording all test results. Copies of these test results shall be submitted to the owner for review prior to final acceptance of the copper cabling system.
5. The contractor shall perform all tests and adjustments, and shall furnish all test equipment necessary and perform all work required to determine or modify performance of the system in accordance with these specifications. The contractor will submit to the owner a complete test plan for Station Wiring/Information outlet (Voice, Data and Network), and Riser Cable to be used for this contract. At a minimum, the plan should show test configurations, calibration procedures, impedances, and measurement equipment. This plan must be approved by the owner prior to the start of testing. The test plan is a one-time requirement and will remain in effect for the duration of this contract unless specifications change requiring a re-submittal. The scope of this work includes, but is not limited to, the following:
 - a. Testing of Category 6 cable shall meet EIA/TIA 568A Requirements.
 - b. The vendor must utilize a check-off list for reference by the owner during tests.
 - c. The result of the measurements outlined shall be recorded and submitted to the owner as final proof of system performance. Electronic results will be supplied in Fluke or equivalent format. If the owner requires specific software to view the results, the contractor will supply a copy of software to the owner.
6. All systems must pass Category 6 specifications and be accepted by the owner before the work will be considered complete.
7. Inter- and Intra-building tie cables: all tie cables will be tested for pass-fail connectivity ground continuity.

G. Fiber Cable Testing

1. Test all fiber with an OTDR, Microtest Certifiber or equal, prior to installation while fiber is still on the shipping reel, using an optical time domain reflectometer (OTDR) or a 850/1300/1510 nm power meter and stabilized light source. Compare test results to the manufacturer's tests. A discrepancy of more than 1 dB on any fiber in either window indicates possible shipping damage and the fiber must be returned to the supplier. Contractor shall keep test results on file for future reference.
2. Test all fiber after installation according to procedures and criteria described in EIA/TIA 455A and all applicable addenda after installation and termination using an OTDR in one direction and an 850/1300/1510nm power meter and stabilized light source in both directions and in both optical windows.
3. All optical test equipment must have current, traceable calibration certification.

H. Test Deliverables

1. Contractor shall submit a complete test plan for station and riser wiring. At a

minimum, the plan should show test configurations, calibration procedures, and measurement equipment. The plan must be approved by the owner prior to the start of testing.

2. Printed ODTR results and tabular loss results must be submitted by the Contractor as documentation of the quality of the installation and as a baseline for future troubleshooting. Compare results to pre-installation tests and document significant changes.
3. Cable test results shall be submitted in hard copy and magnetic format along with viewing software from the tester manufacturer. Hard copy to be bound within loose leaf binder and organized by serving MC or TC, room number of outlet location, and station identifier.
 - a. Four (4) copies of the general Copper, Category 6, and Fiber ODTR results shall be submitted in a tabular, typewritten format at the completion of system testing. The test results must also be provided in a electronic file for future reference.

3.9 RECORD DRAWINGS

- A. All drawings shall be submitted in hard copy with all field changes and contractor labeling indicated in red line updates. Upon completion of the project, Contractor shall deliver to Owner documentation of the project to include:
 1. As-built telecommunications floor plans of the facility with cable, outlet placement and full labels clearly depicted.
 2. As-built elevations of all termination fields describing cable and outlet location labeling scheme, and any changes to the wall elevations and conduit placements in the IT rooms will be recorded on as-built drawings
 3. As-built logical riser diagram describing connectivity and cable sizes, for copper, fiber and grounding cabling systems. Diagram shall include as-built labeling of all OSP and rise cables.

END OF SECTION

SECTION 27 41 00 - AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. This specification shall apply to all phases of Work hereinafter specified, shown on Drawings, or as required to provide a complete installation of Audiovisual Systems as shown in the plans and specifications for this Project. Work required under this specification, may not be limited to just the Audiovisual Systems (AVS) - refer to Architectural, Electrical, Structural, Landscape, Structural Cabling and Mechanical/Plumbing Drawings, as well as all other drawings applicable to this project, which designate the scope of work to be accomplished. It is the intent of the Drawings and Specifications for the Contractor to finalize design, provide and install a complete, fully operational, and tested system.
1. Work Included. Furnish labor, material, services and skilled supervision necessary for the construction, erection, installation, connections, testing, and adjustment of all AVS equipment specified herein, or shown or noted on Drawings, and its delivery to the Owner complete in all respects functional system ready for use.
 - a. Equipment and materials as indicated on the audio-visual drawings.
 - b. Extension rings where required to provide a flush mount surface for cover plate mounting on finished walls.
 - c. Engraved nameplates on the equipment rack and any custom wall plates.
 - d. Coordination of all millwork mounting of any AVS device with the Architect and millwork providers.
 - e. Include work not usually shown or specified, but necessary for proper installation and operation of the system or piece of equipment.
 - f. All conduits, device junction boxes, wall plates and floor boxes, not shown on the electrical drawings, but required to complete the audio-visual system installation.
 - g. Installation of any specialty back boxes, including display backboxes, and speaker rough-in kits with j-boxes and flexible conduit connections.
 - h. Installation of all backing or structural support for flat panel displays, projectors, projection screens, speakers, and other AVS equipment not shown elsewhere in these drawings and specification but required to complete the audio-visual system installation.
 - i. Seismic and safety wires where required.
 - j. Connection of AVS equipment to Fire Alarm shunt wiring as required to mute AV systems during fire alarm event.
 - k. If not provided by others, Design, engineer and provide complete means of support, suspension, attachment and seismic restraint for all AVS equipment, including but not limited to, speakers, displays and projectors. (Hereinafter "support") of the Work of this Specification in accordance with local building codes and regulations. Contractor shall obtain the services of an engineer licensed to perform this work within the State of Jurisdiction it is to be performed.

2. The AVS Contractor Work shall include installation or connection of certain materials and equipment furnished by others. Verify installation details, installation and rough-in locations from the actual equipment or from the equipment shop drawings.
 3. Audiovisual Systems are diagrammatic, and are intended to convey the scope of work, indicating intended general arrangement of equipment. Follow Drawings in laying out Work and verify spaces for installation of materials and equipment based on actual dimensions of equipment furnished.
- B. All miscellaneous system components including, but not limited to, cables, speakers, signal converters, interface panels and components, termination equipment, patch panels, backboards, converters, digital matrix switchers, digital video extenders, controllers, digital signal processors, amplifiers, pre-amps, custom faceplates, mounting hardware, fasteners, racks, cabinets, and any other related items shall be furnished and installed complete under this section, such that the system shall perform all functions listed herein in compliance with all of the specified requirements. Verify functionality of all signal chains for proper operation.

1.2 QUALITY ASSURANCE

- A. Design, manufacture, testing and method of installation of all apparatus and materials furnished under requirements of these specifications shall conform to latest publications or standard rules of the following:
1. AES - Audio Engineering Society
 2. ANSI - American National Standards Institute
 3. AVIXA - Audiovisual and Integrated Experience Association
 4. BICSI - Building Industry Consulting Service International, Inc.
 5. CEDIA - Custom Electronic Design and Installation Association
 6. EIA - Electronic Industries Alliance
 7. FCC - Federal Communications Commission
 8. HDMI Licensing, LLC
 9. IEEE - Institute of Electrical and Electronic Engineers
 10. ISO - International Organization for Standardization
 11. ITU -Telecommunication Standardization Sect
 12. MPEG - Moving Picture Experts Group
 13. NAB - National Association of Broadcasters
 14. NEC - National Electrical Code
 15. NEMA - National Electrical Manufacturers Association
 16. NFPA - National Fire Protection Association
 17. NSCA - National Systems Contractors Association
 18. CALOSHA - Occupational Safety and Health Administration
 19. SMPTE - Society of Motion Picture and Television Engineers
 20. TIA - Telecommunications Industry Association
 21. IBC - International Building Code

- 22. UL - Underwriters Laboratories Inc.
- 23. VESA - Video Electronics Standards Association
- 24. Local Authority Having Jurisdiction (AHJ) Published Standards and Codes

- B. The contractor is required to obtain the latest revisions of these standards and provide the infrastructure which meets the most stringent implementation of these standards.
- C. Perform Work in accordance with the National Electrical Code, applicable building ordinances, and other applicable codes, hereinafter referred to as the "Code." The Contractor shall comply with the Code including local amendments and interpretations without added cost to the Owner. Where Contract Documents exceed minimum requirements, the Contract Documents take precedence. Where code conflicts occur, the most stringent shall apply unless variance is approved.
 - 1. Comply with all requirements for permits, licenses, fees and codes. The Contractor, at Contractor's expense, shall obtain all permits, licenses, fees, special service costs, inspections and arrangements required for Work under this contract, unless otherwise specified.
 - 2. Comply with requirements of the applicable utility companies serving this Project. Make all arrangements with utility companies for proper coordination of Work.

1.3 GENERAL REQUIREMENTS

- A. Warranty: Furnish a written guarantee for a period of (1) one-year from date of acceptance. Provide Phone Contact information for service personnel within twenty-four hours of call and for exchange of faulty equipment. This obligation is limited to exclude conditions of misuse.
- B. The one-year warranty also includes any software installed on the system. After AVS certification and acceptance, source code changes and/or additional programming, whether requested by the Owner or performed by the Installing Contractor, shall be warranted by the Installing Contractor for a period of one (1) year, with the Installing Contractor responsible for the diagnosis and repair.
- C. The Contractor shall provide an annual "Software Maintenance" contract for consideration. This shall cover all software provided as part of this system and/or written for this system and shall include both routine upgrades to applications and operating systems, as well as any modifications to software that may be required by any of the AVS equipment provided on the project. The Software Maintenance contract shall commence immediately after expiration of the warranty period and continue for three (3) years.
- D. Wherever a discrepancy in quantity of equipment, cable, devices, etc., (all materials), arises on the Drawing and/or Specifications, the Contractor shall be fully responsible for providing and installing all material and services required by the strictest condition noted on Drawings and/or in Specifications to ensure complete and operable systems as required by the Owner and Engineer.

- E. The Contractor shall hold a valid State of California C-7 Low-Voltage license, shall have completed at least 10 projects of equal scope, shall have been in business of furnishing and installing systems of this scope and magnitude for at least five years, and capable of being bonded to assure the owner of performance and satisfactory service during the guarantee period.
- F. The contractor shall hold all other licenses required by the legally constituted authorities having jurisdiction over the work.
- G. All work shall be performed under the supervision of a company accredited by the AVS equipment manufacturer and such accreditation must be presented at the time of the bid.
- H. The installing contractor shall be a factory authorized dealer / installer and warrantee station for the brand of equipment offered at the time of the bid and shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment at time of bid. The installing contractor shall provide availability for spare set of all major parts for the system or have immediate access to replacement equipment.
- I. All of the equipment in this specification shall be furnished and installed by Authorized Factory Installation technicians. The Contractor shall furnish a letter from the manufacturer of all major equipment, which certifies that the installing contractor is the Authorized Installer and that the equipment has been installed according to factory intended practices. The Contractor shall also furnish a written guarantee from the manufacturer that they shall have a service representative assigned to this area for the life of the equipment.
- J. All AV systems equipment supplied shall be listed by Underwriters Laboratories or Nationally Recognized Testing Laboratory. A copy of the listing card for the proposed system shall be included with the contractor's submittal. Any equipment submitted that is not NRTL-listed shall be subjected to on-site testing by AHJ-approved agency at the Contractor's sole cost. All expenses related to such testing, including any repairs or replacements caused by damage to the equipment shall be borne by the Contractor.
- K. Personnel: Use adequate numbers of directly employed skilled technicians and installers who are thoroughly trained and experienced with the specified requirements and the methods needed for proper performance of the AV systems installation work specified herein. Use of temporary labor or sub-contracted labor shall not be allowed unless explicitly allowed elsewhere in this specification.
 - 1. Designated Project Engineer: Provide a designated Project Engineer in responsible charge of the Design, CAD, In-House testing and on the on-site commissioning of the Project during all phases of the work of this specification. The Project Engineer shall hold a current InfoComm CTS-D along with all applicable AV equipment manufacturer certifications necessary to complete the work specified herein. The Project Engineer shall be the same individual through the execution of the work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene. All Certifications shall be held by the Project Engineer at the time of the bid and shall have at least five (5) years direct experience in similar work.

2. The Lead Technician shall have at least three (3) years direct experience in similar work. The AV technician assigned to this project shall be fully trained, qualified and carry valid and current industry certifications regarding the installation, operation and testing of audiovisual systems. At least one lead technician shall hold a current InfoComm CTS-I, with all applicable AV equipment manufacturer certifications necessary to complete the work specified herein shall be assigned as Lead Technician to the project. All Certifications shall be held by the Lead Technician at the time of bid.
 3. Custom Control System Programmer: Provide Manufacturers Certifications as required for the equipment used on this project. Provide at least one (1) full time programmer on staff, capable of on-site custom programming of the custom remote-control system specified herein. Control System Programmer to hold the following certifications: InfoComm CTS-D, CTS-I or CTS along with Extron Control Professional (ECP) Certification, and Extron AV Associate certifications, or Crestron Master Programmer, at least Silver Level., or equivalent Certification from AMX, QSC Level 2. A programming Sub-Contractor may be used as long as the Programmer has the certifications as listed above. The AV Contractor shall take full responsibility to provide a properly programmed AV System.
 4. Designated Project Manager: Provide Manufacturers Technician's Certifications as required for the equipment used on this project. Provide a designated Project Manager in responsible charge of the fabrication shop and on the Project Site during all phases of installation and testing of the work of this specification. The Project Manager shall hold current InfoComm CTS-D, CTS-I or CTS, and Extron AV Associate certifications or applicable and equivalent Certifications for Crestron or AMX, QSC Level 2 and shall be the same individual through the execution of the work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractor intervene.
 5. Commissioning Personnel shall have a current AQAV Certified Quality Technician (CQT) certification in good standing and shall be capable of performing AV commissioning tests during staging and final commissioning of the system according to the AV 9000: Quality Management System for the Audio-Visual Technology Industry.
- L. All the equipment in this specification shall be furnished and installed by the Authorized Factory Installer of the equipment with the most current software & firmware package available at the time of installation.
- M. Software – Control System, DSP, and All Other Applicable Equipment
1. At the time of Owner Acceptance of the installation, all equipment shall include any and all updated software or hardware revisions including source code to allow the Owner to make alternations and modifications to AVS programming to include, but not limited to all custom programs for remote control system touch panels, control systems, Digital Signal Processors. The software developer shall retain intellectual property rights to the operation software. The Owner shall be granted a license in perpetuity for use. The following requirements shall apply:
 - a. A written release shall be given by the Installing Contractor for all control programming done by the Installing Contractor's personnel or sub-contractors. The release shall acknowledge the Owner's ownership and right to modify programming directly, or to have the or to have the programming modified by

others on the Owner's behalf. The programming code provided must be the latest version. Provide a date in the code file name.

- b. No program resident in a control system shall be overwritten until a back-up of the resident program is made or programming modified by others or the owners' behalf.
- c. All source code changes must be fully documented.
- d. At the completion of the project, (3) USB drives shall be supplied to the Owner with the written release that includes the program and source code for the system in an unencrypted format. All documentation, not residing in the code in Adobe PDF and Microsoft Office format. The programming code provided must be the latest version. Provide a date in the code file name.

N. Verifying Drawings and Job Conditions:

- 1. This Contractor shall examine all Drawings and Specifications in a manner to be fully cognizant of all work required under this Section.
- 2. This Contractor shall visit the site and verify existing conditions. Where existing conditions differ from Drawings, adjustment(s) shall be made, and allowances included for all necessary equipment to complete all parts of the Drawings and Specifications.

O. Operation, Control Programming and Touch Panels

- 1. It is imperative for the AV Contractor to interview the Owner's staff to gather and document the various operational modes including signal routing of the DSP-Control System, IP Video Systems, Device Control Requirements to ensure any controlled device is properly integrated into the Control system. Control via the QSC Touch Panels, Control Room Computer and other Existing System must be integrated as required.

1.4 WORK IN COOPERATION WITH OTHER TRADES

- A. Examine the Drawings and Specifications and determine the work to be performed by the Architectural structural cabling, electrical, mechanical, structural, and other trades. Provide the type and amount of AVS materials and equipment necessary to place this work in proper operation, completely wired, tested and ready for use. This shall include all additional conduits, boxes and other devices for the required operation sequence of all AVS equipment.
- B. Low voltage conduit, boxes and power provided by division 16 or 26000 contractor.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver equipment until site conditions are adequate to receive work; protect items from weather while in transit.
- B. On-Site Storage
 - 1. The Contractor shall be responsible coordinate and maintain a secure storage space.

2. If this storage space is required to be on-site it shall be the Contractor's responsibility to coordinate the size and spatial requirements with the Owner.
 3. The Contractor shall assume full responsibility for the storage space and all contents, unless otherwise indicated by the Owner.
 4. The Contractor shall examine the site and the Programmatic Documents and review with the Owner the designated areas of access, delivery, and storage for the Contractor's use. The Contractor agrees that such areas are satisfactory and sufficient for their needs in the completion of their work and in conformance with the terms of this Contract.
- C. Store materials indoors in ventilated areas with constant, but minimum, temperature of 60 degrees F and a maximum temperature of 90 degrees F and maximum relative humidity of 25% to 55%.
- D. Protection from Damage
1. The Contractor shall provide all protection necessary to safeguard their work from damage by their operations and the operations of others. Unless the Contractor proves to the Owner's satisfaction that the Work has been damaged by others, the Contractor shall promptly repair, adjust, and clean all defective installations and bear all associated costs.

1.6 RECORD DRAWINGS

- A. Drawings of Record:
1. The Contractor shall provide and keep up to date, a complete record set of drawings. These shall be corrected daily and show every change from the original Drawings. This set of prints shall be kept on the job site and shall be used only as a record set. This shall not be construed as authorization for the Contractor to make changes in the layout without written direction in each case. Upon completion of the work, a set of reproducible Contract Drawings shall be used to denote all changes as noted on the record set of prints shall be incorporated thereon with black ink in a neat, legible, understandable and professional manner. Refer to the Supplementary General Conditions for complete requirements.

1.7 APPROVALS, EQUALS, SUBSTITUTIONS, ALTERNATIVES, NO KNOW EQUAL

- A. Approvals: Where the words (or similar terms) "approved", "approval", "acceptable", and "acceptance" are used, it shall be understood that acceptance by the Owner, Architect and Engineer are required.
- B. Equal: Where the words (or similar terms) "equal", "approved equal", "equal to", "or equal by", "or equal" and "equivalent" are used, it shall be understood that these words are followed by the expression "in the opinion of the Owner, Architect, and Engineer." For the purposes of specifying products, the above words shall indicate the same size, made of the same construction materials, manufactured with equivalent life expectancy, having the same aesthetic appearance/style (includes craftsmanship, physical attributes, color and finish), and the same performance.

- C. Substitution: For the purposes of specifying products “substitution” shall refer to the submittal of a product not explicitly approved by the construction documents/specifications.
1. Substitutions of specified equipment shall be submitted and received by the Engineer ten (10) days prior to the bid date for review and written approval. Regulatory Agency approval for all substitutions shall be the sole responsibility of the Contractor. To receive consideration, requests for substitutions must be accompanied by documentary proof of its equality with the specified material. Documentary proof shall be in letterform and identify the specified values/materials alongside proposed equal values/materials. In addition, catalog brochures and samples, if requested, must be included in the submittal. ONLY PRE-BID APPROVED PRODUCTS, ISSUED VIA A FORMAL BID ADDENDUM TO ALL BIDDERS, WILL BE ALLOWED ON THE PROJECT. REGARDLESS OF THE APPROVAL ON ANY SUBSTITUTION, ALL BIDS SHALL BE BASED ON THE PRODUCTS EXACTLY AS SPECIFIED. PRICING FOR EACH APPROVED SUBSTITUTION SHALL BE INCLUDED IN THE BID SUBMITTAL AS A SEPARATE LINE ITEM.
 2. If the Contractor proposes to substitute the specified speaker system(s), the Contractor shall be responsible to provide the Owner & Engineer with an AMFG Electronic and Acoustic System Evaluation and Response Analysis (EASERA) model depicting equal or better performance in both uniformity of direct field response and Speech Transmission Index (STI) as compared to the specified speaker system.
 3. In the event that written authorization is given for a substitution after award of contract, the Contractor shall submit to the Engineer quotations from suppliers/distributors of both the specified and proposed equal material for price comparison, as well as a verification of delivery dates that conform to the project schedule.
 4. In the event of cost reduction, the Owner shall be credited with 100 percent of the reduction, arranged by Change Order.
 5. The Contractor warrants those substitutions proposed for specified items shall fully perform the functions required.
- D. Alternates/Alternatives: For the purposes of specifying products, “alternatives/alternates” may be established to enable the Owner/Architect/Engineer to compare costs where alternative materials or methods might be used. An alternate price shall be submitted in addition to the base bid for consideration. If the alternate is deemed acceptable, written authorization will be issued.
- E. No Known Equal: For the purposes of specifying products, “No Known Equal” shall mean that the Owner/Architect/Engineer is not aware of an equivalent product. The Contractor will need to submit a “Substitution” item, per the requirements listed above, if a different product is proposed to be utilized.

1.8 SHOP DRAWINGS/SUBMITTALS

- A. Shop Drawings/Submittals shall be submitted within 20 working days of a notice to proceed, in digital sets accompanied by Letter of Transmittal, which shall give a list of

the number and dates of the drawings submitted. Drawings shall be complete in every respect and bound in sets.

- B. The Shop Drawings/Submittals submitted shall be marked with the name of the project, numbered consecutively and bear the approval of the Contractor as evidence that the Contractor has checked the Drawings. Any Drawings submitted without this approval will be returned to the Contractor for resubmission.
- C. If the shop drawings show variations from the requirements of the Contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in the Contractor's letter of transmittal. If the substitution is accepted, the Contractor shall be responsible for proper adjustment that may be caused by the substitution. Samples shall be submitted when requested.
- D. Only products listed as "Equal" within the contract documents, along with formally approved "Substitutions" will be reviewed. Products not conforming to these items will not be reviewed and will be returned to the Contractor for re-submittal.
- E. Review comments used in response to shop drawings/submittals are:
 - 1. "No Exception Taken" - Product approved as submitted.
 - 2. "Furnish as Corrected" - Re-submittal not required, although the Contractor shall provide the submitted product with corrections as noted.
 - 3. "Revise and Resubmit" - Re-submittal required with corrections as noted.
 - 4. "Rejected" - Re-submittal required based upon the originally specified product.
- F. Original, Contractor provided shop drawings shall be submitted on the following but not limited to: Note: AutoCad backgrounds will be provided.
 - 1. Audio, Video, and Control System one-line diagrams with cable type and cable numbering provided.
 - 2. AV Equipment Rack Elevations
 - 3. AV Floor, Ceiling and Elevation Plans.
 - 4. Control Panel & Touch Panel screen layouts
 - 5. AV equipment attachment drawings with structural engineer's stamp if required.
 - 6. All other products called out on drawings that call for shop drawing submittal.
- G. All equipment specified an/or required for a complete and operational AV and Control system shall be listed in the projects equipment list submittal.
 - 1. Provide the AV and Control equipment list divided into room/area sections with the AV device Manufacturer in alphabetical order.
 - 2. For Example:
 - a. Classroom 125
 - 1) Extron TLP1025 Touch Panel
 - 2) FSR PL-500 Floor Box.

1.9 MAINTENANCE, SERVICING, INSTRUCTION MANUALS AND WIRING DIAGRAMS

- A. Prior to final acceptance of the job, the Contractor shall furnish to the Owner at least four (4) copies of operating and maintenance and servicing instructions, as well as four (4) complete AV System wiring diagrams for the following, but not limited to, items or equipment:
 - 1. Audio, Video, and Control Systems.
 - 2. Rack Elevations.
 - 3. Touch panel layout pages
 - 4. Current Programming source code.
- B. All wiring diagrams shall specifically cover the system supplied. Typical drawings or consultant supplied drawings will not be accepted. Four (4) copies shall be presented to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment: All AVS materials and equipment, including custom-made equipment, shall be new and shall be listed by Underwriter's Laboratories (UL) and bear their label or be listed and certified by a Nationally Recognized Testing Lab (NTRL) that is also recognized by the local Authority-Having-Jurisdiction (AHJ).
- B. Frequency Coordination. Prior to ordering equipment, the Installing Contractor shall coordinate the frequencies of all wireless devices to prevent unwanted interaction between devices and rooms. This includes, but is not limited to, wireless microphones, assisted listening system devices, wireless control panels, etc. Verification of Frequency coordination shall take place with the use of a spectrum analyzer and frequency allocation/analysis software.

2.2 SYSTEM FUNCTIONS AND CAPABILITIES:

- A. The AVS (If applicable) shall be utilized for presenting, viewing and listening to multimedia presentations. The system shall utilize/integrate where indicated, computer, microphone, and other inputs for output to the Video Projector, LCD/LED Displays, and Sound Reinforcement Systems. The AV system shall be controlled by a Touch Panel interface with DSP system processors. The control system shall be able to control the required functions of the AV equipment, audio volume, audio switching, paging and control. See AV drawings for more detailed information regarding specific system functionality.
- B. The AVS shall provide clear, natural sound uniformly distributed throughout the designated areas. The system shall utilize speakers as shown on the plans. The AV system shall also be able to display High-Definition Video to the Native Resolution of all displays without any distortion or artifacts.

- C. The system shall have adequate dynamic range without audible clipping or distortion to accommodate all types of program material. Audio, Digital Signal Processing shall be employed in the designated rooms to insure smooth frequency response, high acoustical gain before feedback. When at maximum level, the system shall operate without audible distortion, rattles and buzzes. All switching shall be silent and without pops and or transients.
- D. The system frequency response shall:
 - 1. Be within +/- 1.5 dB from a curve which is flat from 80Hz to 10 kHz.
 - 2. There shall be a minimum 12dB per octave roll-off below 32 Hz.
 - 3. Uniformity of coverage of the system at seated ear height (42") shall be within +/- 1.5dB in the 4 kHz 1/3 octave band at any seat location using pink noise as a test signal.
- E. System noise shall not exceed an equivalent input noise of -120dB based on a 20 KHz-noise bandwidth. The predominant noise component in the system output under any operating condition shall be that of the input stage.
- F. The sound level capability of program material levels produced in all seats shall be at least 98 dB when measured with a scaled filter, set at "C Weighting". There shall be at least 6dB of amplifier headroom.
- G. The system shall provide clear audio to all areas covered by the system. All side, Left & Right and any stage lip, or under balcony speakers shall be wired discretely to the correct channel on the amplifier. See AVS drawings for exact location.
- H. EDID and Color Space Management. EDID data exchange is a standardized means for a display to communicate its capabilities to a source device. It is the AVS contractor's responsibility to address and resolve and manage all EDID and Color Space issues.
- I. HDCP (High-bandwidth Digital Content) is an encryption protocol for copy protected video content as Blu-Ray Disc, HD movie downloads, Cable TV & Satellite TV. It is the Contractor's responsibility for proper HDCP 2.2 and Digital Rights Management (DRM) in all systems listed in plans and this specification. This shall apply to all HDMI, DVI or Display Port signals. HDCP is not applicable to SDI signal lines, and no attempt to pass encrypted material through these signal paths shall be attempted.
- J. CEC (Consumer Electronics Control) is device control functions between all connected HDMI devices. It is the AVS contractor's responsibility for proper CEC Management in all systems listed in plans and this specification.

2.3 SOFTWARE PROGRAMMING

- A. General: Except when otherwise agreed in writing the client shall retain legal and beneficial ownership of all Intellectual Property, including source code, created by the Contractor, their employees and sub-contractors.
- B. The Contractor must allow sufficient time for the programming of all software configurable audio, video and control systems. Contractors must evaluate the systems

functional requirements and user interface and then allow time in their bid accordingly. The system description as well as the end user interview will provide the Contractor with the necessary information needed to proceed with the programming. Any questions as to the systems functional requirements must be sent in written RFI form to the Consultant. All programming schemes must be submitted to the Consultant for approval before programming starts. This includes the appearance of all user interfaces, touch panel layouts, preset and sub-preset information (acquired through client interviews), and speaker control schemes. The Contractor shall also submit a narrative for the control system concept to the Consultant for approval. The Contractor is to interview the Owner and their representatives to acquire the necessary information needed to allow for the proper programming of this system. The Contractor, after interviewing the Owner, shall then submit a written report stating his interpretation of the client's requirements for approval by consultant. Only after the Client and Consultant have approved the programming report may the Contractor proceed with the programming of this system.

- C. All equipment that is connected to the Client's local area network and is configurable via the local area network must have its equipment software installed onto dedicated computers provided by the Client. The Contractor is to allot time to install and test equipment software onto a minimum of two of the Client's computers which are to be identified by the Client and/or Consultant. The computers shall be programmed to emulate user interfaces throughout the facility. The Contractor shall coordinate all software deployment over IP with the Client's Information technology department.
- D. A user-friendly/easy to use graphical interface programmed by the Contractor shall allow for easy operation of the system. This interface shall allow novice users the control of the system components without having to access the digital schematic diagram. These main system components shall include master volume control, zone volume control, room combining, routing, switching, source-equipment level control and any other control necessary for the system to function properly from a user standpoint.
- E. Control system minimum programming outlined below:
 - 1. The Contractor shall allot as many hours as required for on-site control system programming with the Client's representative.
 - 2. The Control System in this project may connect to the Client's Local Area Network (LAN). This connection will provide desktop computers control of the audio-visual system as well as make available remote troubleshooting via the internet and (If applicable) Extron Global Configurator Plus and/or Global Configurator Professional. The Contractor shall provide time to install control system interface software on at least three desktop computers. Coordinate work with Client's Information Services personnel.
 - 3. Provide password protection to each control surface in this facility.
 - 4. Touch panels shall be activated and deactivated by password. Upon start up a password dialog box shall be presented to the user to enter his/her password. Only after entering a password will the user have access to the system. The system shall be programmed to shut down automatically after being idle for a time to be specified by the user.

5. Touch panel layout design shall conform to the InfoComm International “Dashboard for Controls” and programming guidelines. Touch panel designs are to be custom to this project. Re-purposed touch panel designs are not acceptable.
6. Control Help File: Each touch panel shall include a help file that will explain each layer of the touch-panel control scheme.
7. Control system shall utilize help desk software to provide:
 - a. Real-time monitoring (If Possible) of: Control system, Device monitoring, Projector lamp life, System online status, Room activity, Remote system diagnostics via Contractors help desk, Remote system control, Fault reporting via email alert, Logging of help request, User access control via password protection, Event logging, report and chart generation.
8. All serial-controlled devices must have bi-directional communication with the control system. All control functions locally available on each device must be accessible via the remote-control system. All locally gestured control functions must mirror on the control system user interface. In other words, if a volume control is adjusted on a DSP interface that adjustment must register on the control interface.
9. Control system shall be used to power up and down connected equipment if required.
10. All projectors shall be monitored and report lamp hours remaining and lamp failure if required.

F. Complexity of Programming:

1. It is required that the Contractor be experienced in the specified Control System. and shall have experience in Professional programming and programming systems of this complexity. Contractors shall allow enough time in their bid to permit extensive programming of all software configurable audio, video and control systems to the requirements of the client and consultant. Contractor shall break out cost associated with programming of these systems for review by the Consultant. By submitting this bid, the Contractor agrees that they understand systems of this type and that all programming services are included to the satisfaction of the Owner and Consultant. The Contractor further agrees that they shall not make any claim for additional monies because of misinterpretation of programming requirements.
2. It is imperative for the AV Contractor to interview the user’s staff to gather and document the various operational modes including signal routing of the DSP-Control System, IP Video Systems and Dante Device Control Requirements to ensure any controlled device is properly integrated into the Control system. Control via the QSC Touch Panels, Control Room Computer and other Existing System must be integrated as required.
3. The Dante Network will be quite extensive and must be labeled and organized. Dante routing presets will be provided, as necessary.
4. The IP Video and all AV network switches must be configured properly for trouble free operation. Pay particular attention to the IP Video network switch programming. Proper switch CONFIGURATION and VLANS MUST be provided as required.

G. Control System Programming. Minimum Touch Panel Functions. Coordinate all functional programming with the owner before final programming sign off.

2.4 AUDIO/VISUAL SYSTEM PRODUCTS

- A. The system shall utilize AV products as shown on the Plans referenced here, unless otherwise specified. The products referenced here shall be considered to be the minimum quantity, performance, functionality and quality levels. If additional and/or upgraded components are needed to meet the performance requirements of this final design-build specification, the contractor shall include all costs for such added and/or upgraded components in the base bid.

2.5 GENERAL PRODUCTS FOR SYSTEMS

- A. See Sheet AV6.10 for the major equipment list
 - 1. PROVIDE ALL REQUIRED COMPONENTS FOR A COMPLETE, OPERATIONAL AV AND CONTROL SYSTEM AS DESCRIBED IN THIS DOCUMENT AND ON THE AV DRAWINGS.

2.6 CABLE – ALL SPACES

- A. Speaker Cable, 70-Volt distribution, Plenum Rated 2-Conductor, 14 AWG, unshielded pair: Extron, West Penn, Belden or equal.
- B. Loudspeaker Cable Plenum Rated 2-Conductor, 12 AWG, unshielded pair: Extron, West Penn, Belden or equal.
- C. Loudspeaker Cable Plenum Rated 2-Conductor, 14 AWG, unshielded pair: Extron, West Penn, Belden or equal.
- D. Analog Microphone/Line Level Installation Cable, 22 AWG conductor, jacketed, shielded, twisted-pair, Plenum Rated: Extron, West Penn, Belden or equal.
- E. Control System Device Control (RS232, Relay or Contact Closure): (Dual 22 AWG shielded twisted pairs with individual drain wires, each pair is color-coded Red/Black and Green/White to simplify identification.) Plenum Rated: Extron, West Penn, Belden or equivalent.
- F. Data Network: Plenum-rated Category 6, see Structured Cabling Specifications for additional requirements.
- G. Serial Digital Interface Cable RG6/U, 75 Ohm Coaxial Cable Belden 4694R or equal. 12G-SDI up to 258'. Provide the correct BNC connector for the specified cable. Provide 12G-HD-SDI extension if cable runs are longer than 225'.
- H. Provide plenum rated cable for all cable where required by code. Any cable changes or substitutions must be submitted and approved prior to installation. Non-compliant cable that has been installed without approval shall be replaced at the Contractor's expense.
- I. Fiber, OM4. MM, 50 micron / 6 strand or strands as required.
- J. Video over IP, CAT6 Belden, West Penn or equal.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION DESCRIPTION

- A. The installation, configuration and wiring of the system shall be executed in accordance with the drawings and the equipment manufacturer's installation instructions and guidelines. Should any variations in these requirements occur, the Contractor shall notify the architect before making any changes. It shall be the responsibility of the factory-authorized installer of the approved equipment to install the equipment and guarantee the system to operate as per plans and specifications.
- B. Workmanship on the installed systems shall be of professional quality, best commercial practice and accomplished by persons experienced in the techniques and standards of the particular industries involved.
- C. Furnish all Additional conduits, AV Back-boxes, conductors, equipment plugs, terminal strips, etc., and labor to install a complete and operable system.
- D. The cables within the rack or cabinets shall be carefully cabled and laced with Velcro wraps. All cables shall be numbered for identification. Cables should have enough slack to allow removal of equipment for service without having to cut multiple Velcro ties or wire wraps. Power plugs need to be labeled at PDU.
- E. Splices of conductors in underground pull boxes are not permitted.
- F. All communications cabling used throughout this project shall comply with the requirements as outlined in the NEC Articles 725, 760, 770, and 800 and the appropriate local codes. All copper cabling shall bear UL listed type CMP (Plenum Rated) and/or CM/G (General Purpose) and/or CMR (Riser Rated). All fiber optic cabling shall bear OFNP (Plenum Rated) and/or OFNR (Riser Rated) and/or OFN/G (General Purpose). Contractor is responsible for installing appropriately rated cable for the environment in which it is installed.
- G. The Contractor shall thoroughly clean all equipment and materials. All exposed parts of the equipment, cabinets, and other equipment shall be left in a clean condition, unblemished and free of all dirt, dust, smudges, spots, fingerprints, etc., The Contractor shall remove all debris and rubbish occasioned by the work from the site. The Contractor shall thoroughly clean all buildings of any dirt, debris, rubbish, marks, etc., Caused by the performance of this work.
- H. The Conduit System. Each conduit shall contain wires or cables of the same signal level or the same type of circuitry only. Low Level Lines, medium level lines, video level lines, high level lines and data and control circuits should be run in their respective separate conduits.
- I. Wiring and Cabling. During installation both ends of all single wires or cables shall be marked with consecutive approved number markers, and a careful running log kept of route and terminations. After attachment at terminations these markers shall be

accessible and readable for identification. A detailed wiring diagram shall be furnished with these numbers shown. At the operational level (i.e., Audio-Visual equipment receptacle boxes, etc.) all receptacles shall be clearly marked by function and number (when there are many of the same function). For example, where a given microphone line may appear at several locations, the same label shall show.

- J. Power distribution cables shall not be installed adjacent to signal cables. Power distribution cabling shall be on the opposite side of the equipment enclosure from signal cables and shall be uniformly located throughout the installation.
- K. Wherever signal lines entering the equipment areas must be connected into the racks, the use of intermediate terminal strips shall be used. This shall also facilitate the testing of maximum increments of the systems in the Contractor's shop. UTP Cables shall terminate in a Patch Panel and / or Switch. All connections of lines at terminal strips, as well as at signal receptacles, shall be mechanically secured and then soldered. No unsoldered connections shall be permitted.
- L. Where lines approach the racks and terminal strips they shall also be mechanically anchored at the rack, and provided with sufficient slack length to avoid strain, abrasion or wear. All cable entry shall be through the tops of racks or through entrance holes in the base of the rack. No cable shall enter racks through front, rear or side panel openings. For equipment mounted in drawers or on slides, the interconnecting cables shall be provided with a service loop of appropriate length. Cables shall not protrude from the back of racks. All system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means.
- M. System Grounding.
 - 1. The "spider" concept is designed to avoid ground loops and inductive coupling.
 - 2. The systems shall be hum free, stable and free of oscillation with the earth ground temporarily disconnected.
 - 3. The earth ground shall be made at only one point in the system as indicated and shall be in accordance with National Fire Protection Association 70-2014.
 - 4. The grounding method shall insure that the system is free of the following problems under any mode of operation:
 - a. RF oscillation, pickup and interference.
 - b. Distortion.
 - c. Crosstalk.
 - d. Signal Leakage.
 - e. Very high frequency feedback.
 - f. Audio Hum.
 - 5. The equipment racks shall be isolated from, and not electrically connected to, the building grounding system. This means that the conduit system shall not be electrically connected to the equipment racks and that the equipment racks shall be installed so that they are electrically isolated from the building structural steel. The racks shall be electrically connected at only one point to the isolated grounding system.

6. In order to ensure the least amount of cable un-twisting, it is required that all cables shall be stripped using a special tool.
 7. The use of lubricants (i.e., Yellow 77) to facilitate the installation of cables in conduits is highly discouraged. If such a lubricant must be used, the Contractor shall verify the acceptability of the lubricant to be used with the cable manufacturer, prior to using such a lubricant.
 8. Under no circumstance are "channel locks" or other pliers to be used.
 9. Plenum rated cable may be run exposed above ceilings, provided the cabling is supported independent of other utilities such as conduits, pipes, and the ceiling support systems. The cables shall not be laid directly on the ceiling panels. The use of cable ties shall be done in accordance with the cable manufacturer's requirements. The cable jacket composition must meet local and all other prevailing fire and safety codes.
 10. Labeling
 11. Wiring Labels: At all connection points for all types of cable & wiring, a label strip shall be attached indicating the name/number of that cable or wire as follows:
 - a. At internal locations (inside racks, cabinets, or boxes), a pressure sensitive label shall be used.
 - b. At external locations, a printed label covered with clear shrink wrap or approved labeling system shall be used.
 12. Equipment Labels: All active components shall have labels at the front and rear. Labels shall be applied plumb and neat and shall not cover any equipment lights, recessed controls, or control labels.
 - a. Front labels shall indicate functional use of equipment.
 - b. Rear labels shall indicate system schematic reference designation.
- 3.2 PERFORMANCE TESTS OF THE COMPLETE SYSTEM. (SEE SECTION 3.08 FOR FINAL INSPECTION)
- A. Verify that all wiring is correctly and completely installed.
 - B. Verify that the entire system performance is in accordance with the design requirements.
 - C. All these tests, and any others that the Contractor may wish for his own satisfaction, shall have been performed and successfully achieved before observation is requested. The Owner's representative may request repetition and demonstration during observation of certain of these tests or other critical tests if problems become apparent. If specifications are not met, further observations shall be at the Contractor's expense.
 - D. Sealing of openings between floors, into or through rated fire and smoke walls, existing or created by the contractor for placement of new or removal of old cable into or through shall be the responsibility of the contractor. Sealing material (Approved UL listed system) and application of this material shall be accomplished in such a manner that is acceptable to the local fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the

drawings shall be the responsibility of the contractor's work. Any openings created by or for the contractor and left unused shall also be sealed as part of this work.

- E. Firestopping work shall be performed by a single contractor to maintain consistency and accountability on the project.
1. The Contractor shall install penetration firestop seal materials in accordance with design requirements, and manufacturer's instructions.
 2. The Contractor's installer shall be certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements.
 3. All installed through penetration firestops shall be identified via label, or stencil. Label shall state that the fill material around the penetrating item is a firestop, and that it shall not be disturbed unless by an authorized contractor. The label shall include the firestop brand name, and the classified system number for which it was installed.
 4. Sample Label:
 - a. MANUFACTURER'S NAME
 - b. ATTENTION
 - c. Fire Rated Assembly
 - d. For Any Changes to This System, Please Refer to UL System Listed Below
 - e. PRODUCT
 - f. HOUR RATING
 - g. UL SYSTEM
 - h. INSTALLATION DATE
 - i. INSTALLED BY
 - j. LICENSE NUMBER
 - k. PHONE
 - l. FAX
- F. Equipment Rack and Equipment Testing and Adjusting Procedures: Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment, establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustments and document the setting of all controls, parameters of all corrective networks, voltages at key system interconnection points, gains and losses, as applicable. Submit test report with color photographs of each equipment rack, front and back. Perform at least the following procedures:
- G. Preliminary: Verify: Grounding of devices and equipment. Integrity of signal and Audiovisual system ground connections. Proper provision of power to devices and equipment. Integrity of all insulation, shield terminations and connections.
- H. Integrity of soldered connections. Absence of solder splatter, solder bridges. Absence of debris of any kind, tools, etc. Routing and dressing of wire and cable.

1. All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
 2. Mechanical integrity of all support provisions.
- I. All new equipment racks shall be bolted to the floor/millwork by the Contractor once the Owner determines the exact location for new rack. Contractor to verify the original Middle Atlantic racks are bolted to floor and seismic bracing are installed to code. The earthquake mounting brackets for each rack kit shall be screwed to studs, not drywall. All equipment shall be serviceable in the rack's final location – the need to unbolt racking equipment to access or service equipment is not acceptable.
- J. Cleaning
1. Clean each section or area of where the work was conducted after completion to permit immediate use of the area.
 2. Remove and discard all refuse, rubbish, and debris.
 3. The Contractor shall ensure that all recyclable and environmentally hazardous waste materials are disposed properly.
 4. Make good all existing structures, surfaces, and utilities affected by cutting, coring, mounting, drilling, or other new work.
 5. Clean all furnished equipment of dust, dirt, fingerprints, smudge, and other material prior to calling for a Substantial Performance of Work Review or Completion of Work Review.

3.3 PROTECTION

- A. During the installation phase and up to the date of achieving Substantial Performance of Work, protect finished or unfinished work against damage or loss. In the event of such damage or loss, immediately replace or repair such work or equipment at no cost to the Owner.

3.4 SPECIFIC SYSTEM INSTALLATION REQUIREMENTS

- A. The installer shall, upon completion of the system, orient all antennas, speakers, align all projectors, screens and displays, adjust all controls, etc., to provide a system operating at maximum capability. Submit block diagram and shop drawing of equipment.

3.5 GENERAL TESTING REQUIREMENTS

- A. Provide all instruments for testing and demonstrating in the presence of the owner's inspector that the all audio, digital video and control parameters are as stated in the factory data sheets. Check all circuits and wiring to verify they are free of shorts and grounds.
1. Equipment and components in need of adjustment, repair or replacement and discovered during such testing, shall be immediately adjusted, repaired or replaced

with all new equipment and that part of the system shall then be retested. All such replacement or repair shall be done at no additional cost to the owner.

3.6 SPECIFIC AUDIO TESTING REQUIREMENTS

- A. Furnish all laptops, software, equipment and personnel to conduct these tests in accordance with the performance specification requirements. ANSI and EIA Standards.
 - 1. Audio testing and adjustment:
 - 2. Adjust all audio levels. Measure and record absolute impedance at 400 Hz and 1 kHz for each speaker line. Correct polarity of all speaker lines.
 - 3. Each "leg" of every individual speaker line shall be measured using a voltmeter to ensure that there are no shorts to ground.
 - 4. When the system is brought to full power, there shall be no hums, buzzes, rattles, or indication of any abnormal speaker noise.
 - 5. Audio check for continuity, polarity, cold solder connections, shorts and opens.
- B. Provide full flat panel monitor display calibration and adjustments for optimal picture quality for a single HDMI input. Provide proper aspect ratio configuration for both 16:9 and 16:10 sources. Use a test generator (I.E. Extron VTG or equal): for all setup verification and verify proper image configuration with all inputs. (Contract the Owner's Technical Representative prior to final adjustment to coordinate).
 - 1. Controls: Adjust all controls to achieve the specified performance. Provide shaft-locks or covers for all level controls, as appropriate to prevent unauthorized gain changes. Contractor shall confirm that all control system operations are properly programmed and repeatable.
 - 2. Contractor shall review and assess the appropriate Lens Throw length between all video projectors and the projection screens to ensure optimum picture sizing and focus. Make all adjustments necessary, including projector keystone correction and lens shift to achieve the image size and shape required.
 - 3. Provide full video projector calibration and adjustments for optimal picture quality for all used inputs. Provide proper aspect ratio configuration for 4:3, 16:9 and 16:10 sources. Set all projector configuration presets required for control system recall coordination and provide with final system documentation.
 - 4. Testing Report: Provide a letter/report documenting the results of these preliminary tests, including amplifier gain/level settings, DSP EQ filter settings, and AV equalization curves for review by the AV Design Consultant and Owner.
 - 5. The Contractor is fully responsible align, program, and test the sound speaker system to include the left, right, and center arrays as well as subwoofer speakers where these occur, to the respective speaker manufacturer specifications as required to achieve required uniformity of coverage as specified herein.
 - 6. Contractor shall and utilize provide the following Calibrated Test Instruments as a minimum during commissioning and acceptance testing:
 - 7. Sensitive AC voltmeter, -80dBu sensitivity or more, 20Hz -30KHz response, able to measure signal to noise ratio, THD, electrical levels within the system. Note that some systems require measurements up to 100 volts and may require an external pad.

8. Sound Pressure Level Meter, ANSI Type I with A and C weighting filters, fast or time averaged.
 9. Audio Signal Generator, 20Hz-30kHz, sine wave, pink noise, and continuous sine wave sweep.
 10. Amplified Loudspeaker 100 mm producing 60 dBa at one meter, and 70 dBa at one-meter, pink noise, sine wave, and speech files.
 11. 200Mhz Oscilloscope, with TV sync (analog video only). Analog Signal Generator NTSC/PAL, plus computer patterns at all required resolutions and refresh rates required for the systems under test. For systems with composite video, include Pluge pattern. (Analog video only)
 12. Digital Signal Video Generator for computer patterns for all resolutions and refresh rates required for the systems under test, HDMI/DVI/HD-SDI with and without HDCP.
 13. The ability to measure STI-PA (source analyzer).
 14. Colorimeter/luminance meter, 10% accuracy.
 15. Infrared thermometer.
- C. Test media with known levels (audio, video, etc.): Cd's, VS, DVD's etc.
1. AD/DC multimeter.
 2. Light meter, lux/foot-candles.
 - a. Outlet tester (to test power outlet wiring).
 - b. The ability to measure electrical power (watt meter, clamp meter, etc.).
 - c. Cable sets, cable assemblies, adapters as required to sample and measure in-or-out of circuit as req'd.
 - d. Computer with Smaart v8 or Systune. Outboard Dual Channel Preamplifier and Calibrated microphones. Earthworks M23 or equal.
 - e. All equalization shall be accomplished using FFT Transfer Function. No real time analysis methodology shall be allowed.
 - f. Verification of Frequency coordination shall take place with the use of a spectrum analyzer and frequency allocation/analysis software.
 - g. Testing Report: Provide a letter/report documenting the results of these preliminary tests, including amplifier gain/level settings, crossover filter settings, and AVS equalization curves for review by the AV Design Consultant.

3.7 SPECIFIC AUDIOVISUAL SYSTEM NETWORK CABLING TESTING REQUIREMENTS

- A. Category 6x Cable Testing.
1. The Contractor shall provide competent, factory-trained engineers and/or technicians, authorized by the manufacturer of the cabling system, to technically supervise and participate during all tests for the systems.
 2. The Contractor shall test and certify the cabling system to minimum standards as set forth in the ANSI/TIA/EIA-568-C specifications for Category 6A cable as appropriate.
 3. General Requirements – Category 6A.
 - a. Every cabling link in the installation shall be tested for:

- 1) Wire Map
 - 2) Length
 - 3) Insertion Loss
 - 4) NEXT Loss
 - 5) PS NEXT Loss
 - 6) ELFEXT Loss
 - 7) PS ELFEXT Loss
 - 8) Return Loss
 - 9) Propagation Delay
 - 10) Delay Skew in accordance with the field test specifications defined in ANSI/TIA/EIA-568-C. This document will be referred to as the "TIA Cat 6A Standard."
- b. In addition to testing the "In-link" performance parameters detailed in 3.a above, Alien Crosstalk testing or "Between-link" testing shall be carried out in accordance with Annex E of the TIA Cat 6A Standard. Alien crosstalk testing includes the PS ANEXT and PS AACR-F (Power sum alien attenuation-to-crosstalk ratio from the far end) performance parameters. The standards refer to the link-under-test for Alien Crosstalk as the disturbed link.
- c. PS ANEXT and PS AACR-F shall meet or exceed the limits defined in Section 7.8 of the TIA Cat 6A Standard.
4. The installed twisted-pair horizontal links shall be tested from the Switch located in the equipment rack to all end points throughout the AV System for compliance with the "Permanent Link" performance specification as defined in the TIA Cat 6A Standard.
 5. One hundred percent of the installed cabling links must pass the requirements of the standards mentioned in 3.a above and as further detailed in Section B. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section C below.
 6. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BiCSi or the ACP (Association of Cabling Professionals).
 7. The test equipment (tester) shall comply with the accuracy requirements for level IIIe field testers as defined in the TIA Cat 6A Standard. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table I.1 of Annex I of the TIA Cat 6A Standard. (Table I.1 in this TIA document also specifies the accuracy requirements for the Channel configuration.)
 8. The test plug shall fall within the values specified in test plug NEXT loss requirements of the TIA Cat 6A Standard.
 9. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

10. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
 11. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in ANSI/TIA/EIA-568-C). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
 12. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.
 13. Owner or owner's representative shall be invited to witness field testing. The representative shall be notified of the start date of the testing phase five business days before testing commences.
- B. Category 6A – Performance Test Parameters: The test parameters for Cat 6A are defined in the TIA Cat 6A standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 500 MHz) must meet or exceed the limit value determined in the above-mentioned standard.
1. Wire Map: Shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.
 2. Length: The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for NVP (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.
 3. Insertion Loss (Attenuation): Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz through 500 MHz in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured

(worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

4. NEXT Loss: Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 500 MHz. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin and the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

Table 1 -- Maximum frequency step size as defined in

Frequency Range (MHz)	Maximum Step size (MHz)
1 - 31.25	0.15
31.26 - 100	0.25
100 - 250	0.50
250 - 500	1.00

5. PSNEXT Loss: Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 500 MHz and the step size may not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
6. ELFEXT Loss, pair-to-pair: Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through 500 MHz and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard as in Table 1. Minimum test results documentation (summary results):

Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

7. PSELFEXT Loss: Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
8. Return Loss: Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.
9. Propagation Delay: Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.
10. Delay Skew [as defined in the TIA Cat 6A Standard; Section 7.5] This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.
11. PS ANEXT: Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel must also be included as disturbing links in this test.
12. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS ANEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

13. PS AACR-F: The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity.
14. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS AACR-F. If the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

C. Category 6/6A Test Result Documentation

1. The test results/measurements shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.
2. The database for the completed job shall be stored and delivered on CD-ROM including the software tools required to view, inspect, and print any selection of test reports.
3. A paper copy of the test results shall be provided that lists all the links that have been tested with the following summary information
 - a. The identification of the link in accordance with the naming convention defined in the overall system documentation
 - b. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 - c. The date and time the test results were saved in the memory of the tester.
4. General Information to be provided in the electronic data base with the test results information for each link:
 - a. The identification of the customer site as specified by the end-user
 - b. The identification of the link in accordance with the naming convention defined in the overall system documentation
 - c. The overall Pass/Fail evaluation of the link-under-test
 - d. The name of the standard selected to execute the stored test results
 - e. The cable type and the value of NVP used for length calculations
 - f. The date and time the test results were saved in the memory of the tester
 - g. The brand name, model and serial number of the tester
 - h. The identification of the tester interface

- i. The revision of the tester software and the revision of the test standards database in the tester
 - j. The test results information must contain information on each of the required test parameters that are listed in Section B and as further detailed below under paragraph C6.
5. In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for must contain the following information:
 - a. For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.
 - b. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m and the test limit value
 - c. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
 - d. Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
 - e. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair
 - f. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
 - g. NEXT, ELFEXT: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link
 - h. PSNEXT and PSELFEXT: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
6. Between-Link (Between-Channel) Test Results Data. A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report must contain
7. PS ANEXT results at each frequency (See Table 1) for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PSANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center), the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.
8. PS AACR-F results at each frequency tested (See Table 1) for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACRF only needs to be measured and tested from one end of the link or channel. Connect the main DTX-1800 unit (measurement of PS AACR-F disturbance) to the disturbed link or channel at the end where all cabling links are terminated at a distribution panel. Select End 1 in the AxTalk Analyzer Software.

- D. Optical Fiber Cable Testing: All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in Section 3 of this specification. Testing shall consist of a bi-directional end to end OTDR trace performed per ANSI/TIA/EIA 455-61 & ANSI/TIA/EIA 526 and a bi-directional end to end power meter test performed per ANSI/TIA/EIA 455-53A. The system loss measurements shall be provided at 850 and 1300 nanometers for multimode fibers and 1310 and 1550 for single mode fibers.
1. Pre-installation cable testing: The Contractor shall test all lightguide cable prior to the installation of the cable. The Contractor shall assume all liability for the replacement of the cable should it be found defective during the warranty period.
 2. Loss Budget: Fiber links shall have a maximum loss of: (allowable cable loss per km)(km of fiber in link) + (.4dB)(number of connectors) = maximum allowable loss.
 3. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to Owner.
- E. HD-SDI coax cable testing
1. 12G HD-SDI – Adhere to SMPTE OV2082-0.2018 Standards.
 2. 11.88 Ghz Support.
- F. The Contractor shall provide test documentation to the Owner's Project manager in a three ring binder(s) and CD format within three weeks after the completion of a specific project. The binder(s) shall be clearly marked on the outside front cover and spine with the words "Test Results", the project name, and the date of completion (month and year). The binder shall be divided by test type. Test data within each section shall be presented in the sequence listed in the administration records. The test equipment by name, manufacturer, model number, and last calibration date shall also be provided at the end of the document. Unless a more frequent calibration cycle is specified by the manufacturer, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test.
- G. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be collocated in the binder.

3.8 FINAL INSPECTION AND ACCEPTANCE (SEE SECTION 3.02 FOR ADDITIONAL REQUIREMENTS)

- A. After all requirements of the Specifications and/or the Drawings have been fully completed, representatives of the Owner will inspect the work. Contractor shall provide competent personnel to demonstrate the operation of any item or system to the full satisfaction of each representative.
- B. Final acceptance of the work will be made by the Owner after receipt of approval and recommendation of acceptance from each representative.
- C. Upon testing by Owner's Representative (Consultant) any deficiencies shall be noted. If the deficiencies are not correctable at the time of testing, any retesting costs by the

Consultant, including any travel and lodging expenses shall be borne solely by the Contractor.

3.9 ACCEPTANCE TESTS – PUNCH LIST JOB WALKS

- A. Qualification for Acceptance: After completing preliminary testing, the Contractor shall furnish the Construction Manager with the letter/report documenting the results of the preliminary tests and two (2) copies of "as-built" wiring diagrams of the entire system including the connection numbers, and their locations. The receipt of this documentation shall constitute the Contractor's acknowledgment that the installation is complete and conforms to this specification and is ready to be reviewed and tested by the AV Design Consultant.
- B. Acceptance Test: The Consultant, Owner's Representative and/or Construction Manager will be present during the acceptance testing and require the assistance and cooperation of the AV Installation Contractor. Provide personnel who participated in the actual installation and preliminary testing and adjustment of the audiovisual systems.
- C. Equipment cabinet keys and any tamper-proof fastener tools must be available to the AV Design Consultant. Delays associated with failure to access the equipment shall be back charged to the Contractor at the AV Design Consultant's current hourly rates.
- D. Each major component shall be demonstrated to function, as specified.
- E. The AV Contractor shall provide a laptop computer with all manufacturers supplied configuration software necessary for communicating with Control Systems, DSP Audio Matrix Mixers, and the Audiovisual System Switchers. A review of system settings may be required for either of the programmable units at the AV Design Consultant's request, and settings may be adjusted if necessary.
- F. Such tests may be performed on any piece of equipment or system. If any test shows the equipment or system is defective or does not comply with the specifications, the Contractor shall perform any remedies at his expense and pay the subsequent expenses of any retesting required.
- G. Delays: If system acceptance is delayed because the system is found to not meet the specification requirements, the Contractor shall reimburse the Owner for all consultant expenses related to re-testing. This shall include costs associated with travel to the site and any associated business travel expenses.

3.10 SYSTEM DOCUMENTATION, TRAINING, AND FIELD SUPPORT

- A. Operation and Maintenance Manuals: For each system, provide three (3) copies of system manuals per system, two (2) for the Owner and one (1) for the AV Design Consultant. Manuals shall be in adequately sized three-ring binders, clearly labeled on spine. Manuals shall contain the following:

- B. Service Reference Cover Sheet: Provide a cover sheet with Contractor name, address, Email, WEB Address, telephone and Fax numbers.
- C. System Operation Instructions: Step-by-step operating instructions for the basic day-to-day use of the system including power activation, connection of source devices, adjustment of volume levels, selection of sources, etc. Include illustrations and references to individual equipment manuals, as necessary.
- D. Equipment Manuals: Include copies of individual equipment operation manuals separated by tabbed dividers. Arrange the manuals in nominal signal path order (i.e., sources first, amplifiers/loudspeakers last), followed by control system manuals, followed by miscellaneous manuals.
- E. Equipment List: List all system equipment including, connectors and specialty hardware, by manufacturer and model and serial number.
 - 1. As-built Drawings: Provide one set, reduced 11"x17" foldout "as built" functional diagrams in clear plastic binder sleeves. Fold and insert drawings so that drawing title is clearly visible at the front of the sleeve. In addition, provide 2 full-size drawing sets.
 - 2. Provide current software programmable device configuration files to the Owner for all control system interfaces and computer-based files, and the DSP Audio Matrix Mixer. Store files on site in the system documentation binders in disk sleeves. Provide the files on USB.
 - 3. Complete spreadsheet lists of IP network devices, protocols used, and IP and MAC Address lists and required ranges for coordination with the Owner's IT department.
 - 4. Provide all network switch configuration files. Identify which configuration file is loaded into each switch.
 - 5. Provide Ip Network diagram with all interconnections and VLANs programmed into the network.
- F. Lists shall include information regarding location on the Owner's network or dedicated audiovisual physical subnet, VPN requirements, and other pertinent information for integration of IP networked audiovisual equipment into the Owner's Enterprise network
- G. Training: Provide hours as needed of system training to operator(s) designated by the Owner. Training time is to be non-contiguous, in multiple separate sessions. Training sessions are to be digitally recorded upon Owner request.
- H. All training shall take place after the systems are operational, but before the acceptance tests.
- I. Operational Training:
 - 1. In the event the Installing Contractor does not have qualified instructors on staff for certain sophisticated equipment, the Installing Contractor, at no additional cost to Owner, shall provide a manufacturer's representative for such instruction to the Owner.
- J. Training Materials Supplied:

1. System operational manual (not equipment operation manuals) that explains how to fully operate the system; from start-up to shut down, and all operational steps in-between, in a step-by-step description, with pictures and other visuals to help convey information.
2. The Installing Contractor shall video record training session(s) for Owners reference (to help limit minor follow up phone calls in the future).

K. Maintenance Training:

1. A session with Owner's designated technical personnel for routine and preventive maintenance shall be given.
 - a. This training is for scheduled preventative maintenance for such items as filter and lens cleaning, minor equipment checks and "user" adjustments.
 - 1) This training is not meant to teach Owner's representatives how to use commercial test equipment and/or do sophisticated equipment/system alignment.

L. Training Materials Supplied:

1. Utilizing the equipment manuals and flow diagrams of the required in contract closeout submittals supply a listing with suggested preventative maintenance schedule of the system equipment.
2. Training Format

M. Presenter: The presenter of the training sessions to have been directly involved with the project and have intimate knowledge of the installed systems and its operation. The presenter to be experience operating similar systems of similar complexity.

N. Attendees: The End User to determine who shall attend Audio & Video Training. Group to be limited to 10 persons. Training to occur at building site and be coordinate with Owner's Schedule and Calendar.

O. Classroom presentation: PowerPoint Presentation covering items indicated in syllabus. Duration of classroom training not to exceed 4 hours.

P. Field Instruction: Hands On presentation covering items indicated in syllabus. Minimum duration of field instruction:

1. Video System Operation – 6 hours
2. Audio System Operation – 6 hours
3. One month follow up – 4 hours.

Q. Audio Systems Training Syllabus

R. Section 1 - Introduction to Audio Systems

1. Decibels – Explain the concept of Decibels and its application in dBu and dBSPL. Provide references of each.
2. Frequency – Explain the concept of Frequencies and a relationship to octaves and musical notes.

3. Voltage – Provide description of microphone, line and speaker levels.
 4. Gain Structure – Provide description and example of proper gain structure along with an explanation of clipping and headroom.
- S. Section 2 – Introduction to Project Systems (Provide the following for each system in project)
1. Inputs – Present floor plans indicating location of technical panels with brief description of input connectors.
 2. Controls – Present floor plans indicating location of wall controls and mix locations.
 3. Review the setup and adjustment of the output devices.
 4. Review the maintenance of the video equipment.
- T. Section 3 – Microphone Selection and Application
1. Provide explanation of proper microphone selection to include:
 - a. Type of microphone: Boundary, Condenser, Dynamic, etc.
 - b. Type of coverage: Omni, Cardioid, Semi Cardioid, etc.
- U. Provide explanation of proper microphone application to include:
1. General Handling and placement for handheld applications
 2. General Handling and placement for stand applications
 3. 3 to 1 rule with respect to interference
 4. 3 dB rule with respect to headroom
- V. Section 4 – Field Instruction
1. Mixing Console Operation
 2. Explanation of signal path
 3. Review of Aux sends
 4. Review of Groups
 5. Explanation of Mute Groups
 6. Explanation of Matrix
 7. Review of Main Section
 8. Review of Metering
 9. Tie Line Description
- W. Video System Training Syllabus
- X. Section 1 – Introduction to Video Systems
1. Provide description of digital and analog video signal types.
 2. Discuss the properties of a quality video image.
- Y. Section 2 – Introduction to project systems
1. Inputs – Present floor plans indicating location of technical panels with description of input connectors.

2. Controls – Present floor plans indicating location of wall controls and mix locations.
3. Components – Present Schematic diagram (based on shop drawings) indicating description of signal flow and components of the system.

Z. Section 3 – Field Instruction

1. Demonstrate the process of inputting media.
2. Review the process or routing the signals through distribution.
3. Review the setup and adjustment of the output devices.
4. Review the maintenance of the video equipment.

AA. Support Materials

1. Training Manuals - Provide three ring binders for each attendee with the following:
 - a. Cover sheet indicating Audio Training.
 - b. Contact information for Audio Contractor and Audio Consultant
 - c. Table of Contents
 - d. Printed copy of PowerPoint presentation.
 - e. Copy of Materials List
 - f. Copy of Loose Equipment Materials List and Product Cut Sheets
 - g. Owners and Instruction Manuals. Make Owners and Instruction manuals available and complete for reference during training.
 - h. Record Documents Make Record Document available and complete for reference during training.
 - i. Submit training support material binder to AV Consultant for approval prior to training sessions.

BB. Follow-up training within sixty (60) days shall also be provided.

CC. Single Point of Contact: Contractor shall provide an English proficient, single point of contact, i.e., Project Manager, to speak for the Contractor and to provide the following functions:

DD. Initiate and coordinate tasks with Owner's Project Manager, and others as specified by Owner's Project Manager.

EE. Provide day-to-day direction and on-site supervision of Contractor personnel.

FF. Ensure conformance with all Contract provisions.

GG. Participate in weekly site project meetings as needed.

HH. This individual shall remain as Project Manager for the duration of the project. The Contractor may change Project Managers only with the Owner's Project Manager's written approval.

II. Planning meetings and schedule: Within thirty (30) calendar days after the date of award of the Contract, an initial planning meeting shall be held with the successful bidder to

clarify all requirements (systems, services, distribution methods, etc.), identify responsibilities, and schedule the events that shall transpire during the implementation of the project. Within one (1) week of this initial meeting, the Contractor shall provide a written report and project schedule to clearly document the events and responsibilities associated with the project.

- JJ. Site Cleaning: Throughout the progress of the plant construction, the Contractor shall keep the working area free from debris of all types and remove from the premises all rubbish resulting from any work done by Contractor. Daily and at the completion of its work, the Contractor shall, to the extent possible, leave the premises in a clean and finished condition.
- KK. Safety Requirements: Contractor shall utilize appropriate personnel and display warning signs, signals, flags and/or barricades at the work site to ensure adherence to safety regulations and as prudence requires.
- LL. Specification/Drawing Status: All specifications and drawings related to this project shall be "frozen" after shop drawing approval. The Owner reserves the right to negotiate any future changes with the Contractor at any time.
- MM. Upon approval of shop drawings, Contractor shall immediately place orders for all required materials, components, and supplies. In addition, Contractor shall secure and forward written confirmations (including orders and shipping dates) direct from each manufacturer/vendor to the Owner's Project Manager.
- NN. Contractor shall expedite shipment of all materials, components and supplies, as necessary to ensure the successful completion of the Project by the date required. All costs for expediting shall be included within Contractor's pricing as provided below.
- OO. The system cost herein shall include administration/maintenance training for at least ten Owner's representatives with a minimum allotment of sixteen (16) hours. Additional hours of training shall be as required at no additional expense to the owner. All training shall include written and/or video materials that shall remain the property of Owner. If materials are written, they shall be provided in quantities sufficient for each person trained; if materials are video, one copy of each shall be required. The administration/maintenance training shall include, but not be limited to, the following:
- PP. Review of as-built documentation, including a site demonstration.
- QQ. All warranty information.

3.11 DAMAGES

- A. The Contractor shall be held responsible for any and all damages to portions of the building caused by it, its employees or sub-contractors; including but not limited to:
- B. Damage to any portion of the building caused by the movement of tools, materials or equipment.

- C. Damage to any component of the construction of spaces.
- D. Damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.
- E. Damage to the materials, tools and / or equipment of the Owner, its consultants, agents and tenants.

3.12 INSPECTIONS

- A. On-going inspections shall be performed during construction by the Owner's Project Manager. All work shall be performed in a high-quality manner and the overall appearance shall be clean, neat and orderly. The following points will be examined and must be satisfactorily complied with:
- B. Are all cables properly labeled, from end-to-end?
- C. Have all terminated cables been properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?
- D. Have the pathway guidelines been followed? Are all cable penetrations installed properly and fire stopped according to code?
- E. Has the Contractor avoided excessive cable bending?
- F. Is Cable fill correct?
- G. Are terminations compatible with applications equipment?
- H. Are connectors properly turned right side up in the Jack Panels or faceplates without cables wrapped or twisted?
- I. Is the jacket maintained right up to the termination?
- J. Are identification markings uniform, permanent and readable?

3.13 COMPLETION OF WORK

- A. At the completion of the System, the Contractor shall restore to its former condition, all aspects of the project site and daily, shall remove all waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract. All clean up, restoration, and removal noted above shall be by the Contractor and at no cost to Owner. If the Contractor fails in its duties under this paragraph, Owner may upon notice to the Contractor perform the necessary clean up and deduct the costs thereof from any amounts due or to become due to the Contractor. It shall be the

Contractor's responsibility to remove trash from the areas it is working in and bring trash and debris to the Contractor provided dumpster.

- B. Final Punch Walk: The Contractor and owner shall complete a final inspection to determinate if all conditions of the scope of work are completed to the owner's satisfaction. A "punch list" shall be formulated within (2) days of the punch walk and be presented to the Contractor for completion prior to final project sign-off by the owner. If an item is missed during the punch walk or not included on the "punch list" for any reason, it does not release the Contractor from completing the scope of work as defined in the specification or drawings.
- C. Contractor shall submit complete Record Documentation as outlined in submittals section prior to project sign-off by owner.

3.14 SYSTEM AND/OR NETWORK TESTING

- A. Upon completion of installation, Contractor shall execute all the required tests as summarized in this specification. When all such tests have been completed to Owner's satisfaction and Manufacturer's specifications, Contractor shall give the Owner written notice thereof.
- B. Contractor must assume responsibility of assuring that the system and network interface installed operates properly, including any required coordination with other suppliers.

3.15 FINAL ACCEPTANCE

- A. The Owner or Owner's representative may visit the site during the installation of the system to ensure that correct installation practices are being followed.
- B. The Owner or Owner's representative will conduct a final job review once the Contractor has finished the job. This review will take place within one week after the Contractor notifies the owner.
- C. Two copies of all certification data and drawings for all identifications shall be provided to the Owner before the owner's review.
- D. The Owner or Owner's representative will review the installation and certification data prior to the system acceptance.
- E. The Owner or Owner's representative may test some of the systems features to ensure that the certification data is correct. If a substantial discrepancy is found, the Owner reserves the right to have an independent consultant perform a certification of the entire system. If such a procedure is undertaken, the cost of the testing shall be billed back to the Contractor.
- F. If repairs, or adjustments are necessary, the Contractor shall make these repairs at his own expense. All repairs shall be completed within 5 days from the time they are discovered.

- G. The Contractor shall hand to the owner a copy of any applicable installation specific software configurations in USB format.

END OF SECTION

DIVISION 28

ELECTRONIC SAFETY AND SECURITY

SECTION 28 05 13 – SECURITY WIRE AND CABLE
PART 1 - GENERAL

1.1 OVERVIEW

- A. This section shall define the Moorpark City Library (hereinafter referred to as Owner), standard cabling design and installation criteria.

1.2 RELATED WORK NOT IN THIS SECTION

- A. General and specific provisions of these standards apply to the work detailed in this Section, as well as:
 - 1. Door Hardware (Division 08)
 - 2. Electrical (Division 26)
 - 3. Communications (Division 27 10 00)
 - 4. Access Control and Alarm Monitoring System (Section 28 10 00)
 - 5. Security Video Management System (Section 28 30 00)

1.3 DESIGN STANDARDS

- A. The design standards outlined in this section shall define the requirements for new security cabling infrastructure.
- B. Design Layout:
 - 1. Include one (1) Type A cable for each alarm contact (or pair of contacts wired in series).
 - 2. Include one (1) Type A cable for each request-to-exit switch (REX) (or pair of REX switches wired in series).
 - 3. Include one (1) Type A cable for each panic button device.
 - 4. Include one (1) Type A cable for each motion sensor or glass break device.
 - 5. Include one (1) Type B cable for each electrified lock.
 - 6. Include one (1) Type C cable for each card reader.
 - 7. Include one (1) Type D cable for each security appliance connected to the network.
 - 8. Include one (1) Type C cable for communication between card reader modules, input modules or output modules.
 - 9. Include one (1) Type E cable for each 12/24 VDC connection from a power supply to a power distribution board.
 - 10. Include one (1) Type E cable for relay control of each output from a card reader module to a power distribution/relay board.
 - 11. Include one (1) Type E cable for relay control of each output from a power distribution/relay board to a field installed power supply.
 - 12. Include one (1) Type A cable for each field installed pushbutton utilized for remote door release.

13. Include one (1) Type G cable for each security appliance connected to the network that requires water blocked construction and/or an extended communication distance beyond 300 feet.

14. Include one (1) Type H cable for each alarm keypad or annunciator.

C. Equipment Design Requirements:

1. Include all data, signal and security power cabling as required to provide a fully function security solution.
2. Cabling shall be sized to allow for voltage drop on long runs and shall be utilize shielding as required to allow 12/24 VDC cabling to be routed adjacent to signal cabling.
3. All cabling shall be free wired above finished ceiling or within 12" from the roof structure if no finished ceiling exists.
4. All cabling installed indoors shall utilize a plenum rated jacket (Type CMP).
5. Signal cabling shall not be run in parallel to 120VAC or higher power cabling.
6. Cabling installed outdoors or below grade shall utilize water blocking technology to prevent water from penetrating the cable cores.
7. Conduit shall be included in areas where accessibility is limited or not possible. Conduit shall be run from the inaccessible area and stubbed to an above ceiling area utilizing acoustic drop-in tiles or a suitable open space.
8. Include designated cabling from each field device to its respective security panel location.

1.4 REGULATORY REQUIREMENTS

- A. Comply with the California Electric Code (CEC) and state codes and ordinances.
- B. Where required, materials shall be listed by Underwriter's Laboratories (U.L.) and shall bear the U.L. Inspection Label.
- C. Materials shall meet with approval of the Division of Industrial Safety, State of California and all governing bodies having jurisdiction.
- D. Where required, use plenum rated cabling and support devices which conforms to the CEC.

1.5 PRODUCT HANDLING

- A. Deliver materials to job site in original, unbroken packages, properly tagged with U.L. label, size, type, and manufacturer indicated.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Unless otherwise noted, all materials and equipment shall be new, of the type, capacity, and quality specified and free from defects. Material shall bear the label of, and be listed by, the Underwriters' Laboratories unless of a type for which label or listing service is not provided.

B. Wire and Cable:

1. Security Signal Cabling – Type A:
 - a. Security signal cabling shall be West Penn Model 25221B, 22 AWG, 2 conductors, twisted, non-shielded, plenum rated or approved equal.
2. Security Lock Power (24 VDC) Cabling – Type B:
 - a. Security power (24 VDC) cabling shall be West Penn Model 25225B, 16 AWG, 2 conductors, stranded, non-shielded, plenum rated or approved equal.
3. Security Card Reader/Card Reader Module Cabling – Type C:
 - a. Security card reader cabling shall be West Penn Model D254852, 24 AWG, 2 pair, stranded, shielded, plenum rated or approved equal.
4. Security Communication Cabling – Type D:
 - a. Security communication cabling shall be West Penn Model 254246, 23 AWG, 4 pair, solid, CAT 6, plenum rated or approved equal.
5. Security Power Distribution (12/24 VDC) Cabling – Type E:
 - a. Security power distribution (12/24 VDC) cabling shall be West Penn Model 25224B 18 AWG, 2 conductors, stranded, or approved equal
6. Power Supply Cabling (120 VAC) Cabling – Type F:
 - a. Security power (24 VDC) cabling shall be West Penn Model 226, 14 AWG, 2 conductors, stranded, non-shielded or approved equal.
7. Security Alarm Communication Cabling– Type H:
 - a. Security Alarm Keypad cabling shall be West Penn Model D253652, 22AWG, 3 Pair (6-conductors), stranded with shield and drain.

2.2 CABLE LABELING

- A. Labels shall be a self-laminating vinyl.
- B. Labels shall have a white background for printing and a clear tab to protect the printed text.
- C. Labels shall be a minimum of 1" wide and 1-1/4" long, the printed area shall be no less than 1/2" high.
- D. Generate labels using a handheld Brady labeler Model BMP21-PLUS or approved equal.
- E. Labels shall be by Brady, Model number M21-1250-427, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Indicate all materials and equipment shall be installed in accordance with manufacturer's recommendations, instructions, and industry standards.
- B. Indicate all cables shall be connected to terminal strips/blocks or to equipment via suitable

factory-furnished or locally furnished connectors. Additionally, indicate cable to rack-mounted equipment shall be long enough to allow complete removal of equipment, even if rear access is totally restricted.

- C. Indicate all intra-rack wiring shall be neatly strapped, dressed, and supported. Terminal blocks, boards, strips, or connectors shall be supplied for all cables that enter or leave racks, enclosures or equipment modules. Additionally, indicate cables shall be grouped according to signals carried.
- D. Indicate NEC approved hangers and strapping devices shall be utilized for installation of wire and cable in ceiling.
- E. Indicate that the entire system shall be supported by engineering documentation in accordance with the provisions of these Design Standards, specifically including:
 - 1. Wiring diagrams showing all devices, terminations, and interconnections.
 - 2. Connection diagrams showing interfaces between the devices, panels, and system head-ends.
 - 3. Cable assignments and terminations, showing all pair assignments and termination locations.

3.2 INSTALLATION OF CONDUCTORS

- A. Indicate conductors shall be continuous between outlets or junction boxes and no splices shall be accepted.
- B. Indicate for wire training and clamping in cabinets and enclosures, use nylon cable ties, bundling no more than eight (8) conductors per bundle to facilitate manual tracing of conductors.
- C. Indicate that open cable runs shall be supported independently. Indicate 12-gauge ceiling wires with "Caddy" type clips and/or bridle rings are provided as required (10' maximum spacing).
- D. Dedicated J-hooks, D-rings and threaded rod with loop hangars shall be utilized to provide a neat and finished installation of security cabling.
- E. Indicate conductors shall be bundle and laced neatly in cable tray/racks, panels, cabinets, and equipment in accordance with accepted professional practice.
- F. Indicate all cabling shall be dressed, laced or harnessed to prevent mechanical stress on electrical connections. Additionally, indicate no wire or cable shall be supported by a single connection point.
- G. Indicate no splices shall be made except as required to terminate devices to the designated equipment.
- H. Indicate all connections made at devices shall be soldered and encapsulated by clear heat shrink tubing. Additionally, indicate that wire nuts, bean connectors, barrel connectors, crimp

connectors, etc. shall not be accepted.

- I. Indicate connections to screw-type barrier strips on panels will be made with insulated crimp-type spade lugs when appropriate. Additionally, indicate that lugs shall be sized properly to assure low resistance connection with a high electrical integrity.
- J. Indicate stranded #14 AWG conductors will be utilized for power circuits.

3.3 LABELING

- A. Indicate cable labeling shall be keyed to the Construction Drawings, as approved by the Owner, such that at each cable end, origination and destination can be quickly and clearly ascertained. Additionally, indicate spare cables shall be so identified.
- B. Indicate label text shall be printed utilizing the "SMALL" text size setting.
- C. Indicate label text shall be printed on three lines utilizing the "WIRE" setting.
- D. Indicate label shall be affixed to cable jacket no more than 1" from where jacket is stripped back to allow ease of cable identification.
- E. Indicate label shall be affixed to cable jacket by adhering the white printed portion of the label directly to the jacketing and then wrapping the clear portion of the label around and over the white printed portion to protect the printed text of the label.
- F. Indicate label shall be positioned so that it can be easily read without needing to adjust or reposition label or surrounding cabling.

3.4 FIELD QUALITY CONTROL

- A. Tests:
 - 1. Indicate that Contractor shall perform end-to-end tests of cable pairs. Additionally, indicate that Contract will verify all assignments and terminations.
 - 2. Indicate documentation of all testing will be submitted to the Owner for approval and verification.
 - 3. Indicate the Contractor will furnish all necessary instruments and equipment required for conducting tests. Additionally, indicate the Contractor shall test all wiring for shorts, open circuits or grounding.
 - 4. Indicate any defective work will be immediately corrected.
 - 5. Indicate that when entire installation has been completed, circuits will be tested to demonstrate that operation of system is in accordance with the Design Standards.

3.5 ADJUSTING AND CLEANING

- A. Indicate that all cable stripping and trimming remnants shall be cleaned from any security equipment enclosures and the surrounding area.

- B. Indicate that exposed parts of all equipment and interior of panels and cabinets shall be cleaned of dirt, cement and plaster and other materials.
- C. Indicate that damaged or scratched materials will be replaced or refinished as required.

END OF SECTION

SECTION 28 10 00 – ACCESS CONTROL AND ALARM MONITORING SYSTEM
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. This section shall define the Moorpark City Library (hereinafter referred to as Owner), Access Control and Alarm Monitoring system (ACAMS) system design standards and installation criteria.

1.2 RELATED WORK NOT IN THIS SECTION

- A. General and specific provisions of these standards apply to the work detailed in this Section, as well as:
 - 1. Door Hardware (Division 08)
 - 2. Electrical (Division 26)
 - 3. Communications (Division 27 10 00)
 - 4. Security Wire and Cable (Section 28 05 13)
 - 5. Digital Video Management System (Section 28 30 00)

1.3 DESIGN STANDARDS

- A. The design standards outlined in this section shall define the requirements for a new ACAMS.
- B. Design Layout:
 - 1. General Requirements:
 - a. Include one (1) rack mounted ACAMS server in the MDF.
 - b. ACAMS server shall be connected to a rack mounted UPS in the MDF.
 - c. ACAMS server shall be connected to a rack mounted KVM in the MDF.
 - d. Security equipment enclosures shall be wall mounted in the MDF.
 - e. Each card reader door included in this design standard shall utilize and integrate the following devices:
 - 1) One (1) wall mounted card reader.
 - 2) One (1) door alarm contact for each monitored leaf of door opening.
 - 3) One (1) or more electrified locks as detailed in Division 08.
 - 4) One (1) request-to-exit switch integrated with door hardware as detailed in Division 08.
 - 2. Site Requirements:
 - a. Provide and coordinate connectivity as required to City of Moorpark monitoring.
 - b. Include one (1) ACAMS Client workstations and monitor for ACAMS administration functions. Coordinate final location of workstation and the

- monitor with the Architect and Owner.
 - c. Include one (1) wall mounted card reader assembly at each exterior entry/exit door of the building.
 - 1) See Technology Plans for card reader locations.
 - d. Include one (1) wall mounted card reader assembly for each door at the following interior spaces.
 - 1) See Technology Plans for card reader locations.
- C. Equipment and Software Design Requirements:
- 1. Include one (1) ACAMS server to support installation of the ACAMS software.
 - 2. Include one (1) Base ACAMS software license to support sixty-four (64) card readers.
 - 3. Include one dedicated desktop workstations and two (2) monitors in the Building for system administration and enrollment.
 - 4. Include a Client licenses as required for the Administration and Alarm monitoring workstations.
 - 5. Include Intelligent Dual Reader Controllers and Dual Reader Interface Modules in each building as required to support integration of the security field devices.
 - 6. Include 12/24 VDC power supplies in each building as required to provide integration of security controllers/modules and electrified locking hardware supplied by Division 08.
 - 7. Include wall mounted security equipment enclosures in each building to house security controllers/modules and power supplies. Each security equipment enclosure shall be supplied with a tamper switch to provide enclosure monitoring.
 - 8. Card readers included in this design shall be configured for OSDB communications between the card reader and controllers.
 - 9. As directed by owner, card readers shall be configured for both Bluetooth mobile credential for use by police officers and card credential use by Administrative Staff. Mobile credential communication shall be enabled for all card reader provisioned exterior doors.
 - 10. Unless otherwise noted, all other building card readers shall be configured solely for card credential use.
 - 11. Include 125 KHz/13.56MHZ card credentials in quantities as coordinated with the Owner.
 - 12. Include pushbuttons connected to the ACAMS for remote door unlock at locations as coordinated with the Owner.
- D. These Design Standards are not meant to be all-inclusive. The Designer shall make adjustments accordingly. Include in the original design, all equipment, software, cabling, connectors, transformers, relays, etc., whether detailed here or not, such that said design fulfills the intent of these standards and renders these systems functional and fully operational.

1.4 DESCRIPTION OF OPERATIONS

- A. The system is designed to receive a signal from a card reader, which is activated by an

authorized card or mobile credential. Upon a valid authorization, an electronic opening device (i.e., electric lock) is activated to allow access. Should an attempt be made to enter this system with an unauthorized card or mobile credential, the electronic device shall not be activated, thus denying entry. This system is also designed to provide for an override by the security system operator at a remote workstation to activate the electronic door device, thus allowing access for certain circumstances which are normally not programmed into the system. Each access or denial shall be recorded.

- B. All access controlled doors equipped with electric locks, shall be configured so that when a card or mobile credential is presented at a card reader, access shall be granted only if the access code is valid, the I.D. number is found, and it is authorized at that location for that particular period. If all conditions are met, a signal shall be sent to the appropriate control hardware and the associated building DPS shall be shunted and the electric locking device shall be unlocked. Upon opening and closing the door on a valid card or mobile credential read, the electronic locking hardware shall re-lock and the DPS shall resume an armed state.
- C. The ACAMS server will be connected to an IP network supplied by Division 27. Coordinate final location of server with the Division 27 Consultant.
- D. Workstations will be connected to the IP network network supplied by Division 27. Coordinate final location of workstations with the Owner.
- E. Intelligent Dual Reader Controllers will be connected to an IP network supplied by Division 27. Coordinate final location of each Intelligent Dual Reader Controller with the Division 26 and Division 27 Designers.
- F. The ACAMS shall be integrated with the Digital Video Surveillance System (DVSS) to allow automated call-up of designated cameras based on active alarm conditions on the ACAMS.
- G. ACAMS system programming shall include, but is not limited to the following:
 - 1. All hardware devices included in the Design Standards.
 - 2. All access and user defined authorization levels as coordinated with the Owner.
 - 3. Input of alarm condition and response messages as coordinated with the Owner.
 - 4. Development of activation alerts and unique messaging by alarm condition and location.
 - 5. Import and configuration of mapping displays for each floor with associated icon links which activate on alarm or event conditions.
 - 6. Integration of ACAMS alarms with the DVSS to allow automated camera call-up as coordinated with the Owner.
- H. Alarm Monitoring Integration: The SYSTEM shall allow for annunciation of intrusion detection alarms in the Main Alarm Monitoring Window. Intrusion Detection alarms reporting into the Main Alarm Monitoring Window shall report just like any other access control alarm and shall have the same annunciation and display properties as access control.

1.5 ACAMS HARDWARE AND SOFTWARE

- A. Coordinate programming of new ACAMS devices with the Owner.
- B. Coordinate system naming conventions with the Owner.

1.6 DEVICE HARDWARE REQUIREMENTS

- A. ACAMS Server and Software:
 - 1. Intent is for the Access Control System to be IP based. Existing System Software: Paxton, Net2. Include an ACAMS server and software as detailed in these Design Standards.
 - 2. Coordinate final mounting location of server with the Division 27 Consultant.
- B. ACAMS Workstation and Software:
 - 1. Include ACAMS workstations and software as detailed in these Design Standards.
 - 2. Coordinate final workstation locations with the Owner.
- C. ACAMS VIDEO MONITORS:
 - 1. Include ACAMS video monitors as detailed in these Design Standards.
 - 2. Coordinate final video monitor locations with the Owner.
- D. Intelligent Dual Reader Controller:
 - 1. Include intelligent dual reader controllers as detailed in these Design Standards.
 - 2. Intelligent dual reader controllers shall be powered by from an external 12VDC power source.
- E. Dual Reader Interface Modules:
 - 1. Include dual reader interface modules as detailed in these Design Standards.
 - 2. Dual reader interface modules shall be powered by from an external 12VDC power source.
- F. Card Readers:
 - 1. Include card readers as detailed in these Design Standards.
 - 2. Card readers shall be powered by 12VDC directly from the intelligent dual reader controllers and dual reader interface modules.
 - 3. Card readers shall be configured and programmed to provide OSDP communication.
- G. Access Credentials:
 - 1. Include card credentials in the type and quantity as detailed in these Design Standards.
 - 2. Include mobile credentials in the type and quantity as detailed in these Design Standards.
- H. Alarm Contacts/Tamper Switches:
 - 1. Include magnetic alarm contacts at each monitored door as detailed in these Design

- Standards, to detect an unauthorized intrusion into the facility. If a door is illegally opened, the contact shall send a signal to the ACAMS indicating an alarmed condition.
2. These alarm contacts shall have the capability of being shunted via a request-to-exit (REX) device. When the system grants access at a controlled point, it shall shunt the alarm input for that controlled point until the specified shunt time has elapsed, or the door is opened and closed. These alarm contact shall also be capable of being shunted via the ACAMS client workstation.
 3. Tamper switches shall be included on all security equipment enclosures.
- I. Door Release Pushbutton:
1. Include door release push-buttons at locations detailed in drawings.
- J. Electronic Lock Hardware:
1. Electronic Locks: Include termination of security system cabling to electronic locks provided under Division 08.
 2. Request-to-Exit Switches (RX): Include termination of security system cabling to RX switches that are integral with the electric locking hardware provided under Division 08.
 3. Power Transfer Hinge: Include termination of security system cabling to power transfer hinges that are provided under Division 08.
- 1.7 POWER SUPPLIES
- A. Power Supplies: Include 12VDC and 24VDC power supplies for all security devices associated with this project including specified battery back-up as detailed in the Design Standards.
- 1.8 RELAY/POWER DISTRIBUTION BOARDS
- A. Relay/Power Distribution Boards: Include 24VDC relay/power distribution boards as detailed in the Design Standards.
- 1.9 POWER DISTRIBUTION BOARDS
- A. Power Distribution Boards: Include 12VDC power distribution boards as detailed in the Design Standards.
- 1.10 BACKBOARD REQUIREMENTS
- A. Include plywood backboards as detailed in the Design Standards.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Unless otherwise noted, all materials and equipment shall be new, of the type, capacity, and quality specified and free from defects. Material shall bear the label of, and be listed by, the Underwriters' Laboratories unless of a type for which label or listing service is not provided.
- B. Materials shall be of same brand or manufacturer throughout for each class of material or equipment.
- C. The following equipment has been selected by the Owner and the Security Consultant to be included based upon performance and integration with other systems included in the Design Standards.

2.2 ACAMS SERVER HARDWARE AND SOFTWARE

- A. The ACAMS server hardware shall be included as follows:
 - 1. Rackmount Server (Dell Precision R7920-2RU):
 - a. Intel Zeon Bronze 3106 (8C/8T, 1.7GGHZ, 9.6GT/S, 11MB, 85W)
 - b. 16GB (2X8GB) 2666MHZ DDR4 RDIMM ECC.
 - c. DVD +/-RW, SATA, Internal.
 - d. 500GB 7.2k RPM 2.5 Serial ATA Hard Drive.
 - e. C1 SATA/SSD 2.5", 1-8 HD.
 - f. Windows 10 IOT Enterprise 2016 Embedded.
 - g. Intel 1350 (4x1Gbit) Quad Port Network Card.
 - h. Sliding Ready Rails without Cable Management Arm and 3 Year warranty.
 - i. Rack Mount Server shall be by Paxton, or approved equal.
- B. The ACAMS server software shall be included as follows:
 - 1. Operating System Software: Microsoft Windows 10 IoT Embedded.
 - 2. Database Software: Microsoft Sequel Express.
 - 3. ACAMS system software: Paxton Net 2.

2.3 ACAMS WORKSTATION HARDWARE AND SOFTWARE

- A. The ACAMS Administration workstation hardware and software shall be included as follows:
 - 1. Mid-Tower Workstation (Dell Precision T5820):
 - a. INTEL ZEON W-2104 CPU (4C, 5.5MB, 4T, 3GHZ, 120W.
 - b. 8GB (1X8G 2666MHZ DDR RDIMM ECC.
 - c. 8X DVD+/-RW.
 - d. 500GB 2.5INCH SERIAL ATA (7,200 RPM Hard Drive).
 - e. INVIDIA NVS 315 (1GB DMS56 TO DVI-I ADAPTER).
 - f. Windows 10 IOT Enterprise 2015 Embedded.

- g. RJ45 Ethernet Port.
 - h. Internal Chassis Speakers.
 - i. (6) USB 2.0 Ports.
 - j. (4) USB 3.0 Ports.
 - k. (1) Serial port.
 - l. USB Keyboard/Mouse.
 - m. 3 Year Limited Warranty.
2. Software:
- a. Operating System: Microsoft Windows 10.

2.4 ACAMS VIDEO MONITORS

- A. Video Monitor:
- 1. 24" Widescreen LCD.
 - 2. 1920 x 1200 Resolution @ 60 Hz.
 - 3. 8ms response time.
 - 4. DVI-D, VGA and Display Port Inputs.
 - 5. 4 x USB 2.0 Type A x USB 2.0 Type B Ports.
 - 6. 1000:1 Contrast Ratio.
 - 7. Video Monitor shall be by Dell, Model U2412M or approved equal.

2.5 ACCESS CONTROL DEVICE HARDWARE REQUIREMENTS

- A. TCP/IP Controller:
- 1. On-board Ethernet 10/100Base-T port.
 - 2. Host communications 38.4 Kbps direct wire (RS-232/RS-485 multi-dropped).
 - 3. Reader communications supports (Clock, Data or wiegand, Data1/Data0), Clock Data and OSDP compatible RS-485 readers and keypads.
 - 4. Battery backed non-volatile storage of 50,000 events.
 - 5. 12 VDC input power.
 - 6. 6 Mb of available on-board memory.
 - 7. Two (2) dedicated digital inputs for tamper and power failure status.
 - 8. Status LED's for heartbeat, upstream and downstream communication.
 - 9. Shall have eight (8) unsupervised/supervised inputs, standard EOL: 1k/1k ohm.
 - 10. Shall have four (4) Form-C 5A @ 30VDC.
 - 11. Shall have two (2) Wiegand reader interfaces.
 - 12. Intelligent Dual Reader Controller shall be by Paxton Access Net2 Plus, Single Door Controller (682-610-US). Reference drawings for locations and quantities of access doors and closets. Any equipment deviations or configuration modifications shall be pre-approved prior to bid.
- B. Card Readers:
- 1. Shall be mounted as detailed in the Design Standards.

2. Shall be read when presented in any orientation or at any angle to the surface of the reader.
3. Support for 125kHz proximity cards:
 - a. HID Proximity
 - b. AWID Proximity
 - c. CASI/GE Security Proxlite.
4. Support for 13.56 MHz smart cards:
 - a. MIFARE DESFIRE EV1/EV2.
 - b. MIFARE Classic - ISO 14443.
 - c. Vicinity Card Serial Number - ISO 15693.
 - d. HID iClass** Card
5. Includes optical tamper switch.
6. Damage or vandalism to the reader shall not damage any other part of the access control system.
7. Outdoor reader operating temperature ranges shall be -31°F to +149°F (-35°C to +65°C).
8. Shall be provided in standard black textured finish.
9. Shall operate on 12VDC with a peak current draw of 73mA.
10. Card reader shall be by HID Plus Mini Mullion Reader, Model# 6005BGB00.
Substitutions must be pre-approved by Owner representative.

C. Credentials:

1. Card Credentials:
 - a. Shall be 26-bit prox.
 - b. Shall be a 125 KHz format.
 - c. Shall be a two-part clamshell design.
 - d. Shall have a laser etched card number.
 - e. Coordinate quantity of credentials with the Owner.

D. Alarm Contacts:

1. Type A – Recess Mounted:
 - a. Shall be single-pole, double throw (SPDT) unit.
 - b. Shall provide dual circuit operation to provide operation suitable for a line supervision circuit.
 - c. Switches shall be capable of initiating an alarm signal when the protected door is opened 1" on the latch side.
 - d. Shall be installed in the door header and the associated magnet shall be installed in the door.
 - e. Match alarm contact color with frame.
 - f. Alarm contact shall be by Interlogix, Model 1076CW or approved equal.
2. Type B – Tamper:
 - a. Shall be single-pole, single throw (SPST) unit.
 - b. Shall be capable of initiating an alarm signal when the protected door is opened

3/8".

- c. Shall be installed inside enclosures requiring a tamper switch.
- d. Tamper shall be by Interlogix, Model 3025T or approved equal.

E. Door Release Pushbutton

- 1. Pushbutton shall have an impact resistant housing.
- 2. Pushbutton shall have nickel plated brass terminals.
- 3. Pushbutton shall have a momentary operation.
- 4. Door Release Pushbutton shall be by United Security Products, Model HUB2SA or approved equal.

F. Electronic Lock Hardware:

- 1. Electric Locks: Electric locks shall be provided by Division 08. Include disassembly and re-assembly as required to provide final termination of ACAMS cabling to the electric lock.
- 2. Request-To-Exit (REX) Devices: REX devices shall be included with electric locking hardware as provided by Division 08. Include disassembly and re-assembly as required to provide final termination of ACAMS cabling to the REX devices.
- 3. Power Transfer Hinge: Power transfer hinges shall be provided by Division 08. Include disassembly and re-assembly as required to provide final termination of ACAMS cabling to the transfer hinges.

2.6 EQUIPMENT ENCLOSURES

A. TYPE A – Large:

- 1. Enclosure shall be fabricated from 19-gauge steel.
- 2. Enclosure shall be black powder coated.
- 3. Enclosure shall be 36.12"H x 30.12"W x 7.06"D.
- 4. Enclosure shall include a tamper switch and cam lock.
- 5. Enclosure shall include a removable metal TM3 backplane.
- 6. Enclosure shall be by Altronix, Model Trove3M3 or approved equal.
 - a. Include equipment mounting magnets by Altronix, Model MM24 (Qty as required).
 - b. Include magnetic cable tie mounts by Altronix, Model WM5 (Qty as required).

B. TYPE B – Medium:

- 1. Enclosure shall be fabricated from 16-gauge steel.
- 2. Enclosure shall be black powder coated.
- 3. Enclosure shall be 27.25"H x 21.75"W x 6.5"D.
- 4. Enclosure shall include a tamper switch and cam lock.
- 5. Enclosure shall include a removable metal TM2 backplane.
- 6. Enclosure shall be by Altronix, Model Trove2M2 and approved equal.
 - a. Include equipment mounting magnets by Altronix, Model MM24 (Qty as required).

- b. Include magnetic cable tie mounts by Altronix, Model WM5 (Qty as required).

2.7 POWER SUPPLIES

A. TYPE A – Power Supply (Reader Boards/Locks):

1. Delivers a 4 amp supply current.
2. Auto switch over to stand-by battery when AC fails w/ zero voltage drop.
3. Filtered and electronically regulated outputs.
4. Short circuit and thermal overload protection.
5. AC fail supervision (form “C” contacts).
6. Low battery supervision (form “C” contacts).
7. Battery presence supervision (form “C” contacts).
8. AC input and DC output LED indicators.
9. 115 VAC input.
10. 12/24 VDC selectable output.
11. Power supply shall be by Altronix, Model eFlow4NB or approved equal.

B. TYPE B – Power Supply (Reader Boards/Locks):

1. Delivers a 6 amp supply current.
2. Auto switch over to stand-by battery when AC fails w/ zero voltage drop.
3. Filtered and electronically regulated outputs.
4. Short circuit and thermal overload protection.
5. AC fail supervision (form “C” contacts).
6. Low battery supervision (form “C” contacts).
7. Battery presence supervision (form “C” contacts).
8. AC input and DC output LED indicators.
9. 115 VAC input.
10. 12/24 VDC selectable output.
11. Power supply shall be by Altronix, Model eFlow6NB or approved equal.

C. TYPE C – Power Supply (Reader Boards):

1. Delivers a 10 amp supply current.
2. Auto switch over to stand-by battery when AC fails w/ zero voltage drop.
3. Filtered and electronically regulated outputs.
4. Short circuit and thermal overload protection.
5. AC fail supervision (form “C” contacts).
6. Low battery supervision (form “C” contacts).
7. Battery presence supervision (form “C” contacts).
8. AC input and DC output LED indicators.
9. 115 VAC input.
10. 12 VDC output.
11. Power supply shall be by Altronix, Model eFlow102NB or approved equal.

D. TYPE D – Power Supply (Locks):

1. Delivers a 10 amp supply current.
2. Auto switch over to stand-by battery when AC fails w/ zero voltage drop.
3. Filtered and electronically regulated outputs.
4. Short circuit and thermal overload protection.
5. AC fail supervision (form “C” contacts).
6. Low battery supervision (form “C” contacts).
7. Battery presence supervision (form “C” contacts).
8. AC input and DC output LED indicators.
9. 115 VAC input.
10. 24 VDC output.
11. Power supply shall be by Altronix, Model eFlow104NB or approved equal.

2.8 RELAY/POWER DISTRIBUTION BOARDS

- A. 12/24-volt AC or DC operation.
- B. Eight (8) independently controlled Class 2 Rated PTC protected power- limited auto-resettable 2.5A outputs.
- C. Eight (8) access control trigger points.
 1. Eight (8) normal open (NO) inputs.
 2. Eight (8) open collector sink inputs.
 3. Any combination of the above.
- D. Relay/Power Distribution Board shall be by Altronix, Model ACM8CB or approved equal.

2.9 POWER DISTRIBUTION BOARDS

- A. 12/24-volt DC operation up to 10A.
- B. Eight (8) individually PTC protected outputs @ 2A per output max.
- C. Power Distribution Board shall be by Altronix, Model PD8ULCB or approved equal.

2.10 BACKBOARD REQUIREMENTS

- A. Include 3/4" fire retardant plywood backboards at locations as required for mounting Security Equipment Enclosures.
- B. Backboards shall be finished with two (2) coats of white paint.

2.11 WIREWAYS

- A. Type A – Wireway:

1. Wireway shall be metal in construction with a standard powder coat finish.
2. Wireway shall be 6" x 6" x 72"
3. Wireway shall be by Hoffman, Model F66T172GVP or approved equal. Include closure plates without knockouts by Hoffman, Model F66GCPNKGV or approved equal.

B. Type A – Wireway:

1. Wireway shall be metal in construction with a standard powder coat finish.
2. Wireway shall be 6" x 6" x 36"
3. Wireway shall be by Hoffman, Model F66T136GVP or approved equal. Include closure plates without knockouts by Hoffman, Model F66GCPNKGV or approved equal.

2.12 ASSOCIATED EQUIPMENT

A. Batteries:

1. Include batteries in the required quantities for each power supply.
2. Batteries shall be provided in 12VDC with a minimum 7ah capacity.
3. Batteries shall be by Yuasa or approved equal.

2.13 ELECTRICAL REQUIREMENTS (120VAC)

- A. All 120VAC should be coordinated with Division 26 at locations requiring installation of security equipment enclosures, low voltage power supplies and power boosters.

2.14 NETWORK REQUIREMENTS

- A. All networking requirements should be coordinated with Division 27 at locations requiring installation of servers, workstations and security equipment enclosures.

PART 3 - EXECUTION

3.1 SECURITY DOOR CONTROL AND MONITORING DEVICES

A. INSTALLATION:

1. Indicate that all materials and equipment should be installed in accordance with manufacturer's recommendations, instructions, and industry standards.
2. Indicate that devices shall be installed straight, level and plumb to walls, doors, finished ceiling and/or finished floors, as applicable.

B. ACAMS HARDWARE AND SOFTWARE

1. Include requirements for final programming and configuration of all security panels and field devices.
2. Indicate that all final configuration and programming of required ACAMS alarm

alerts will be coordinated with the Owner.

C. SECURITY DOOR CONTROL AND MONITORING DEVICES:

1. Indicate that card readers shall be installed flush-mounted (unless otherwise noted), to new junction boxes.
2. Indicate that all wiring from each card reader door shall be run to its respective junction box, wireway, intelligent field processor, power supply or security equipment enclosure with no splices or termination points in between.
3. Indicate that end of line resistors (EOL) will be installed at required field devices to provide 4-state supervision monitoring of all installed devices.
4. Indicate that all devices and EOL resistors shall be tested such that desired conditions occur upon activation, which are within the manufacturer's performance specifications.
5. Indicate that field devices shall be configured in series as required to provide a single alarm point designation for each group of devices.
6. Indicate that individual tampers on power supply enclosure shall be wired in series and monitored as a single alarm point on the system.
7. Indicate that all relays, whether specified herein or not, shall be provided and considered incidental to the project.
8. Indicate that no splices shall be made except as required to terminate devices. All connections made at devices shall be soldered and encapsulated by clear heat shrink tubing. Wire nuts, bean connectors, barrel connectors, crimp connectors, etc. shall not be accepted.

D. ELECTRICAL REQUIREMENTS

1. Indicate that the Contractor shall check the adequacy of all power and wiring before making final connections and applying power to the equipment.
2. Indicate that the Contractor shall include termination of 120 VAC power to all power supplies, devices, and other security equipment as required. Items shall include conduit, wiring and connections from 120VAC junction boxes supplied under Division 26 to each security component requiring 120 VAC power.

E. TESTING

1. Indicate that all alarm contacts shall be tested such that alarm conditions occur upon door actuation, which are within the manufacturer's performance specifications.
2. Indicate that the Contractor shall furnish all necessary instruments and equipment required for conducting tests. All wiring for shorts, open circuits or grounding shall be tested.
3. Indicate that when entire installation has been completed, all circuits will be tested to demonstrate that operation of system is in accordance with the design.

END OF SECTION

LPA
PROJECT NO. 30647
05/23/2025

SECTION 28 30 00 – SECURITY VIDEO MANAGEMENT SYSTEM
PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- A. This section shall define the Moorpark City Library (hereinafter referred to as Owner), Digital Video Management System (DVMS) design standards and installation criteria.

1.2 RELATED WORK NOT IN THIS SECTION

- A. General and specific provisions of these standards apply to the work detailed in this Section, as well as:
 - 1. Door Hardware (Division 08)
 - 2. Electrical (Division 26)
 - 3. Communications (Division 27)
 - 4. Security Wire and Cable (Section 28 05 13)
 - 5. Access Control and Alarm Monitoring System (Section 28 10 00)

1.3 DESIGN STANDARDS

- A. The design standards outlined in this section shall define the requirements for a new DVMS.
- B. Design Layout:
 - 1. General Requirements:
 - a. Include DVMS Hardware and Software shall be located in the MDF.
 - b. Include rack mounted KVM units in the MDF.
 - 2. Site:
 - a. See Technology plans for exterior and interior camera locations.
- C. Equipment and Software Design Requirements:
 - 1. Include network video recorder server hardware as required with a minimum of 1.3 Petabytes of usable storage.
 - 2. Include video recording capacity for up to 230 streams @ H.264, 15fps.
 - 3. Include Enterprise High Density SAN storage optimized for video data.
 - 4. Include one (1) Base license on network video recorder to support up to One Hundred and Twenty (120) cameras.
 - 5. Include one (1) Base Integration license to allow integration of the Milestone XProtect platform into the OnGuard ADV system.
 - 6. Include one (1) camera device license for each camera included in the design.
 - 7. Include one (1) Care Plus device license for each camera included in the design.
 - 8. Include one (1) KVM to allow control for up to eight (8) individual servers.

9. Include specific cameras as detailed in Technology / Security Drawings.
10. Include PoE extenders as required for cameras with network communication runs which exceed 300' in length.

- D. These Design Standards are not meant to be all-inclusive. The Designer shall make adjustments accordingly. Include in the original design, all equipment, software, cabling, connectors, transformers, relays, etc., whether detailed here or not, such that said design fulfills the intent of these standards and renders these systems functional and fully operational.

1.4 DESCRIPTION OF OPERATIONS

- A. The DVMS shall be a video monitoring and recording solution fully integrated with the Access Control and Alarm Monitoring System (ACAMS).
- B. The DVMS shall utilize motion activated recording at a frame rate of fifteen (15) frames per second and shall be capable of individually increasing the recording rate of any camera on the system based on alarm events.
- C. This DVMS shall be configured to store video for no less than three-hundred and sixty five (365) days.
- D. This system shall be capable of recording in a continuous loop, such that when the disk storage array becomes full, the first data written to the drives shall be the first data to be written over.
- E. Cameras shall be connected to a PoE network switch at MDF/IDF locations, which will supply no less than 15.4W per PoE port to each camera.
- F. Cameras which require more than the network switched supplied 15.4W shall utilize a PoE injector mounted adjacent to the network switch.
- G. The DVMS shall be capable of providing automated video call-up of selective cameras to a dedicated video monitor based on alarm conditions generated by the ACAMS.
- H. PTZ cameras shall configured to utilize auto tracking analytics based on motion activation.
- I. System programming shall include, but is not limited to, individual camera resolution, recording frame rate, motion detection, video analytics, alarm integration with the ACAMS and Intrusion, archiving, etc.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Unless otherwise noted, all materials and equipment shall be new, of the type, capacity,

and quality specified and free from defects. Material shall bear the label of or be listed by the Underwriters' Laboratories (U.L.) unless of a type for which label or listing service is not provided.

- B. For compatibility and ease of installation, materials shall be of same brand or manufacturer throughout each class of material or equipment, wherever possible.
- C. The following equipment has been selected by the Owner to be included in these standards based upon performance and integration with other systems included in the Design Standards.

2.2 CAMERA HARDWARE

- A. See DRAWINGS FOR CAMERA QUANTITIES AND PART NUMBERS.

2.3 DVMS

- A. DVMS System Software:
 - 1. Base License:
 - a. (1) Base License
 - b. Milestone XProtect, Model# XPCOBT, or approved equal.
 - 2. Device Licenses:
 - a. (125) Device Licenses
 - b. Milestone XProtect, Model# XPCODL, or approved equal.
 - 3. Five Year Care Plus XProtect Corporate Base License:
 - a. (1) Base License
 - b. Milestone Xprotect, Model# Y5XPCOBT, or approved equal.
 - 4. Five Year Care Plus XProtect Corporate Device License:
 - a. (30) Device Licenses
 - b. Milestone Xprotect, Model# Y5XPCODL, or approved equal.
 - 5. Xprotect Access Control Base License:
 - a. (1) Base License
 - b. Milestone Xprotect, Model # XPABL, or approved equal.
 - 6. Xprotect Access Control Device Licenses:
 - a. (25) Device Licenses
 - b. Milestone Xprotect, Model # XPADL, or approved equal.

2.4 DEVICE HARDWARE REQUIREMENTS

- A. VMS Management Server
 - 1. (2) Xeon Silver 4310 - (4) 8GB DDR4 RAM - (2) 240GB M.2 SSD - (2) 1GbE RJ45 - (2) 10GbE SFP+ - (2) 800W PSU - Windows Server 2019 - 5YR NBD Warranty.
 - 2. Server shall be two (2) rack units in height.
 - 3. Server shall include a Xeon E3-1515M V5 2.8Ghz processor.

4. Server shall include an Intel Iris Pro Graphics P580 video card.
5. Server shall include sixteen (16) Gb of DDR4 Ram.
6. Server shall include two (2) 256 Gb SSD hard drives (configured in RAID 1) for OS/VMS software installation.
7. Server shall include a minimum of four (4) 10 Tb hard drives for video data storage.
Note: Total storage capacity may vary by site.
8. Server shall be by Milestone, Model HX8R or approved equal.
9. Storage drives shall be by Milestone, Model HXGS10TB-4 or approved equal.

2.5 PoE Extenders

- A. Extends Ethernet and PoE connections beyond 100 m.
- B. Compatible with IEEE 802.3af and high PoE 60 W.
- C. IP66/IP67 rated enclosure.
- D. No additional power supply required.
- E. Full rate network throughout the entire extended distance.
- F. PoE Extender shall be by Axis, Model T8129-E or approved equal.

2.6 NETWORK EQUIPMENT (PoE)

- A. Network switches with PoE capability (15.4W per port) shall be provided by Division 27.

2.7 KVM

- A. KVM shall be rack mountable.
- B. KVM shall include one (1) 17" LCD monitor.
- C. KVM shall support eight (8) standard PS2 connections.
- D. Include additional cables as required to support the connection and control of one (1) additional ACAMS server located in the MDF Room equipment rack.
- E. KVM shall be by AP5808 or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Indicate all materials and equipment shall be installed in accordance with the manufacturer's recommendations, instructions, and industry standards.
- B. Indicate that all devices shall be installed straight, level and plumb to walls, doors, finished ceiling and/or finished floors, as applicable.
- C. Indicate exact mounting location of all devices shall be coordinated with Owner prior to installation.
- D. Indicate Contractor shall coordinate, program and test all DVMS components to meet the operational requirements of the Owner.
- E. Indicate programming of camera recording rates shall be coordinated to meet the operational requirements of the Owner. Indicate the the default recording frame rate for cameras included in the Design Standards shall be no less than fifteen (15) frames/sec on motion activation unless directed otherwise by the Owner.
- F. Indicate that programming of the DVMS client workstation display requirements will be coordinated with the Owner.
- G. Indicate individual camera field of view requirements will be coordinated with the Owner.
- H. Indicate that cameras shall be installed in such a way as to prevent obstructions within the field of view.
- I. Indicate that adjustment of camera tilt, angel, and varifocal lens will be performed to achieve the best field of view.
- J. Indicate that cameras will be terminated to network communication and power cabling as detailed in Division 28 05 13.
- K. Indicate that termination of cameras to patch panels and network switches will be coordinated with the Owner.
- L. Indicate coordination and configuration of camera IP addresses with the Owner.
- M. Indicate Contractor will provide one (1) additional adjustment of all cameras at the Owner's request at no additional charge to the Owner.
- N. Indicate all new DVMS server equipment shall be terminated to the new rack mounted UPS power supply. Additionally, indicate the Contractor will coordinate termination of the new UPS power supply to 120 VAC service provided by Division 26.

3.2 ELECTRICAL REQUIREMENTS

- A. Indicate all devices, which have a relationship to the security systems and require power to operate, shall be connected to a 120VAC power source at power supplies, junction boxes, and receptacles, whenever possible. Additionally, indicate Contractor shall

provide conduit, wiring and connections from 120VAC junction boxes supplied under Division 26 to each security component included in the design.

- B. Indicate Contractor shall check the adequacy of all power and wiring before making final connections and applying power to the equipment. Additionally, indicate if such wiring/service is not proper and/or adequate, the Contractor shall notify the Architect in writing requesting specific correction of same. Lastly, indicate, failure to provide proper notification of wiring inadequacies, correction of such inadequacies will be corrected by the Contractor with no additional cost to the Owner.

3.3 TESTING

- A. Indicate Contractor shall furnish all necessary instruments and equipment required for conducting tests. Additionally, indicate Contractor shall test all communication cabling to meet industry standards.

END OF SECTION

SECTION 284600 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Maintenance of fire alarm system under contract for specified warranty period.

1.2 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Section 211300 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- C. Section 233300 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; 2016.
- F. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Drawings must be prepared using AutoCAD Release 2018.

1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
1. Copy (if any) of list of data required by authority having jurisdiction.
 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 4. System zone boundaries and interfaces to fire safety systems.
 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
- E. Evidence of installer qualifications.
- F. Evidence of instructor qualifications; training lesson plan outline.
- G. Evidence of maintenance contractor qualifications, if different from installer.
- H. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- I. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 4. List of recommended spare parts, tools, and instruments for testing.

5. Replacement parts list with current prices, and source of supply.
 6. Detailed troubleshooting guide and large scale input/output matrix.
 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- J. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- K. Closeout Documents:
1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- B. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
- C. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- D. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories - Basis of Design: Silent Knight, 6808 Series Pre-Action Releasing .
- B. Fire Alarm Control Units and Accessories - Other Acceptable Manufacturers:
 - 1. Honeywell Security & Fire Solutions/Fire-Lite: www.firelite.com/#sle.
 - 2. Honeywell Security & Fire Solutions/Silent Knight: www.silentknight.com/#sle.
- C. Initiating Devices and Notification Appliances:
 - 1. Provide initiating devices and notification appliances made by the same manufacturer, where possible.
- D. Substitutions: See Section 016000 - Product Requirements.
 - 1. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with contract documents.

2.2 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
 - 1. Provide all components necessary for a complete operational fire alarm system, regardless of whether shown in the contract documents or not.
 - 2. Protected Premises: Entire building shown on drawings.
 - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the local authority having jurisdiction , which is Ventura County Fire Department .
 - c. Applicable local codes.
 - d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.

4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.
7. Program notification zones and voice messages as directed by Owner.
8. Fire Alarm Control Unit: New, located at Telecom #112.

B. Supervising Stations and Fire Department Connections:

1. Public Fire Department Notification: By remote supervising station.
2. Remote Supervising Station: UL-listed central station under contract to facility.
3. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 telephone lines.

C. Circuits:

1. Initiating Device Circuits (IDC): Class B, Style A.
2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
3. Notification Appliance Circuits (NAC): Class B, Style W.

D. Power Sources:

1. Primary: Dedicated branch circuits of the facility power distribution system.
2. Secondary: Storage batteries.
3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
4. Each Computer System: Provide uninterruptible power supply (UPS).

2.3 FIRE SAFETY SYSTEMS INTERFACES

A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

1. Sprinkler water control valves.
2. Dry-pipe sprinkler system pressure.
3. Dry-pipe sprinkler valve room low temperature.

B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:

1. Sprinkler water flow.
2. Duct smoke detectors.

C. HVAC:

1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.

2.4 COMPONENTS

A. General:

1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Remote Annunciators: Silent Knight 6860 .
- D. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
 2. Manual Pull Stations: SK-PULL.
 3. Smoke Detectors: SK-PHOTO-W.
 4. Addressable Interface Devices: SK-RELAY.
- E. Notification Appliances:
1. Horn Strobes: System Sensor.
 2. Strobes: System Sensor.
- F. Circuit Conductors: Copper or optical fiber; provide 200 feet extra; color code and label.
- G. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- H. Locks and Keys: Deliver keys to Owner.
- I. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 2. Provide one for each control unit where operations are to be performed.
 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 4. Provide extra copy with operation and maintenance data submittal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- B. Obtain Owner's approval of locations of devices, before installation.

- C. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

3.3 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
- D. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.

3.4 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 - 1. Be prepared to conduct any of the required tests.
 - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 - 3. Have authorized technical representative of control unit manufacturer present during demonstration.

4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
5. Repeat demonstration until successful.

B. Occupancy of the project will not occur prior to Substantial Completion.

3.5 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 3. Record keeping required by NFPA 72 and authorities having jurisdiction.
- C. Provide trouble call-back service upon notification by Owner:
 1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- D. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- E. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- F. Comply with Owner's requirements for access to facility and security.

END OF SECTION 284600

DIVISION 31

EARTHWORK

SECTION 311000 - SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Clearing and grubbing of the site, including the removal of debris, vegetation, foreign objects, concrete slabs and foundations, asphalt paving, portland concrete paving and curbs, site lighting and bases, site walls, area drains and catch basins, unwanted existing underground utilities and drain lines, conduits, trees, and other site construction as indicated and as required for grading the site suitable for constructing the proposed project.

1.2 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 011000 - Summary: Sequencing and staging requirements.
- C. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 015713 - Temporary Erosion and Sediment Control.
- E. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- F. Section 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- G. Project Geotechnical Report.
- H. Standard Specifications for Public Works Construction (Greenbook); current edition.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Material: As indicated in the Project Geotechnical Report and approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Erect barriers, fences, guard rails, enclosures, and shoring to protect personnel, structures, the public, and site improvements and utilities to be maintained intact.

- B. Protect and maintain benchmarks and survey control points from disturbance during construction.
- C. Locate and clearly flag trees and vegetation to remain or be relocated.
- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the Owner.

3.2 SITE CLEARING

- A. Comply with other requirements specified in Section 017000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- C. Fill depressions caused by clearing and grubbing operations with material satisfactory to the geotechnical engineer unless further excavation or earthwork is indicated.
- D. Place fill material in horizontal layers in accordance with the recommendations in the project geotechnical report and compact each layer to a density satisfactory to the geotechnical engineer.

3.3 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths is encountered in a manner to prevent intermingling with underlying subsoil or other waste.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.4 EXISTING UTILITIES AND BUILT ELEMENTS

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities, utility structures, and associated appurtenances to remain from damage.
- C. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner's Representative not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Owner's Representative written permission.
- D. Do not disrupt public utilities without permit from authority having jurisdiction.
- E. Protect existing structures and other elements that are not to be removed. Remove unwanted existing utilities as indicated or as uncovered by work, and cap in a manner conforming to Code. Determine status of utility lines encountered that are not shown on the Contract Drawings. If abandoned, remove and dispose of in proper manner.
- F. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 1. Arrange with utility companies to shut off indicated utilities.
 2. Check with local jurisdiction for any needed inspection permits.

3.5 VEGETATION

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, trash enclosure area, paving, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Preservation of existing vegetation: The construction schedule shall consider the amount and duration of soil exposed to erosion by wind, rainfall, and vehicle tracking and seek to minimize disturbed soil during the rainy season. A schedule shall be prepared that shows the sequencing of construction activities with installation of maintenance of soil stabilization and sediment control BMPs.
- D. Do not remove or damage vegetation beyond the limits indicated on drawings.
 1. Exception: Specific trees and vegetation indicated on drawings to be removed.
 2. Exception: Selective thinning of undergrowth specified elsewhere.
- E. Install substantial, highly visible fences at least 6 feet high to prevent inadvertent damage to vegetation to remain:
 1. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
 2. Around other vegetation to remain within vegetation removal limits.
 3. See Section 015000 for fence construction requirements.
- F. In areas where vegetation must be removed but no construction will occur other than previous paving, remove vegetation with minimum disturbance of the subsoil.
- G. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 36 inches.

3. Existing Stumps: Treat as specified for other vegetation removed; remove stumps and roots to depth of 36 inches.
 4. Fill holes left by removal of stumps and roots, using suitable fill material, with top surface neat in appearance and smooth enough not to constitute a hazard to pedestrians.
- H. Dead Wood: Remove all dead trees (standing or down), limbs, and dry brush on entire site; treat as specified for vegetation removed.
- I. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.6 SITE IMPROVEMENTS

- A. Remove existing above and below grade improvements as indicated and as necessary to facilitate new construction.
- B. Demolish and completely remove existing construction as indicated from the site, including subsurface conditions designated to be removed or required to be removed to facilitate the work of the proposed project.
1. Demolish asphalt, concrete, and masonry in small sections. Continuously wet down debris to prevent creation of dust or fire hazard.
 2. Fragments: Remove from the site asphalt and concrete fragments exceeding 6 inches in maximum dimension.

3.7 DEBRIS

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 311000

SECTION 312200 - GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil.
- B. Rough grading the site for site structures.
- C. Finish grading.

1.2 RELATED REQUIREMENTS

- A. Section 311000 - Site Clearing.
- B. Project Geotechnical Report.
- C. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.3 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with the Standards Specifications for Public Works Construction (Greenbook); current edition.
- B. Perform work in accordance with Project Geotechnical Report.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Material: As indicated in the Project Geotechnical Report and approved by the Geotechnical Engineer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Protect from damage above- and below-grade utilities to remain.
- D. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- E. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- F. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- G. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

3.3 ROUGH GRADING

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
 - 1. Remove sod, grass, and any other vegetation before stripping top soil.
 - 2. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
 - 3. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 4. Strip topsoil to depth indicated on drawings.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil , unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Benching Slopes: Horizontally bench existing slopes greater than 1:4 to key fill material to slope for firm bearing.
- G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

- H. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

3.4 SOIL REMOVAL

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
 - 1. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water and other erosion control measures.
 - a. Limit height of topsoil stockpiles to 72 inches.
 - b. Do not stockpile topsoil within plant protection zones.
 - c. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or resued.
- B. Stockpile subsoil to be re-used on site; remove remainder from site.

3.5 FINISH GRADING

- A. Before Finish Grading:
 - 1. Verify building and trench backfilling have been inspected.
 - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 2 inch in size. Remove soil contaminated with petroleum products.
- C. Where topsoil is to be placed, scarify surface to depth of 6 inches.
- D. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 12 inches.
- E. Place topsoil in areas indicated.
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.
- K. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) from required elevation.
- B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).

3.7 REPAIR AND RESTORATION

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.
- C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.8 FIELD QUALITY CONTROL

- A. Compaction density testing shall be as described in the Project Geotechnical Report and as approved by the Geotechnical Engineer.

3.9 CLEANING

- A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 312200

SECTION 316610 - VIBRO STONE COLUMN (VSC)

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Include all design, material, constructino and testing requirements for the Vibro Stone Columns (VSC) to meet the performance criteria defined in this specifcation and on the Drawing for the proposed Library project.
- B. A Specialty VSC Contractor to provide all equipment, material, labor, and supervision to design and install VSC to meet the performance criteria defined in these specifications and on the plans. The design shall rely upon information presented in the contract documents, geotechnical report, and plans.

1.2 REFERENCES AND RELATED DOCUMENTS

- A. ASTM D3441 - Standard Test Method for Mechanical Cone Penetration Testing of Soils.
- B. Geotechnical Reports and addenda for the site.
- C. State of California Department of Transportation (Caltrans) Standard Specification and Test Methods (Latest Edition).
- D. California Building Code, Title 24 Part 2, Volume 1 and 2, Adopted Edition.

1.3 DEFINITIONS

- A. VSC: a compacted rock column in the ground that reinforces the soil and increases the density of the adjacent soil thereby reducing liquefaction potential and related soil settlement. VSC is constructed with dry, bottom-feed vibratory methods.
- B. Specialty VSC Contractor: The specialist subcontractor responsible for the design, construction, and performance of VSC ground improvement outlined in these specifications.
- C. The Engineer shall be the Geotechnical Engineer of Record.

1.4 SUBMITTALS

- A. The Specialty VSC Contractor to submit the following for review and approval by the Engineer at least 2 weeks prior to VSC mobilization:
 - 1. Description of VSC ground improvement process providing all details of both the type and quantity of all equipment, the sequence and duration of construction activities, the type, and frequency of quality assurance procedures, and sources of all materials.

2. Test data on the stone to be used for the construction of the VSC. Test data shall demonstrate that the stone conforms to these specifications and be repeated if the stone's source changes.
 3. VSC test section program as required in these specifications for approval by the Engineer.
 4. Shop drawings showing the spacing and depth of the VSC to achieve the Performance Criteria outlined in these Specifications. The drawings to show dimensioned locations of the VSC with respect to existing facilities. Drawings shall be prepared, signed, and stamped by a registered professional engineer licensed in California.
 5. Detailed calculations that are the basis for the proposed VSC plan. The calculations shall use analytical techniques that are based on widely-accepted industry practice such as that provided in, but not limited to, the Standards and Reference section of this Specification. The Engineer shall review all calculations prepared by the Specialty VSC Contractor.
- B. The Specialty VSC Contractor to furnish a written, daily record with the information required in these specifications of VSC installation to the General Contractor and the Engineer within 48 hours of each VSC installed.

1.5 QUALIFICATIONS OF THE VSC CONTRACTOR TO BE SUBMITTED WITH BID

- A. General: The Stone Column Contractor shall submit a Qualifications Package that demonstrates VSC experience. One (1) Contractor, the VSC Contractor, shall perform all parts of the VSC design and installation. The VSC Contractor shall be experienced in all aspects of VSC design and construction and shall furnish all necessary plant, materials, skilled labor, and supervision to complete the Contract. The VSC Contractor may be the Contractor bidding the job or a subcontractor.
- B. Staff Experience: The VSC Contractor shall submit qualifications of the Project Superintendent, VSC Design Engineer, VSC Rig Operator(s) to be utilized on the project. The Project Superintendent shall be authorized to act on behalf of the VSC Contractor. The Project Superintendent shall have at least five (5) years of on-site experience managing VSC field operations of similar size and scope and shall have supervised at least two (2) projects within the past five (5) years employing the VSC technique proposed for this project. The Project Superintendent shall have experience and knowledge of all aspects of VSC as required for the project and shall be present at the worksite at all times during VSC operations. The VSC Design Engineer shall have at least five (5) years of experience in the design/QC of VSC systems. The VSC Design Engineer shall be a Civil, Structural, or Geotechnical Engineer currently registered by the State of California. The VSC Design Engineer shall supervise review QC records and as-built drawings to confirm that the VSC work meets the design intent. The VSC Rig Operator(s) shall have at least three years of experience using the equipment selected for this project. VSC Contractor shall submit evidence of previous staff experience in the Qualifications Package Submittal. Personnel named in this package shall not be substituted without the express written consent of the Engineer.

- C. Project Experience. The VSC Contractor shall submit evidence of experience and competence to design and construct the VSC. This evidence shall document that the VSC Contractor has at least five years of VSC experience; and has completed at least five (5) projects of similar scope to this project. The VSC Contractor shall submit information on prior projects in the Qualifications Package Submittal to document their qualifications. The projects must have the following characteristics to qualify as acceptable projects. Failure of the Qualification Package to meet these requirements may result in the rejection of the VSC Contractor.
1. Satisfactorily completed at least five (5) projects as Design-Build for liquefaction mitigation using VSCs, during the last three years.
 2. At least five (5) projects show the independent and successful design and installation of structural VSC of similar or greater depth and length.
 3. At least five (5) projects where the VSC Contractor implemented QA/QC programs during VSC treatment.
 4. An ongoing project may be used to satisfy the experience requirements.
 5. Qualifications Package Submittal: The Qualifications Package shall include project and staff experience. For project experience, the VSC Contractor shall submit detailed information on previous projects in the format listed below. The architect may contact any of the listed references to verify the accuracy of the information. Failure to provide accurate and complete information may result in the invalidation of the listed project.
 - a. Name of person in charge of the project for the Contractor.
 - b. Name of the project.
 - c. Location of the project.
 - d. Name of client/owner.
 - e. Name and telephone number of the person in charge of the project for the client. The contractor shall verify that all listed references and telephone numbers are current and complete.
 - f. A description of the project, including a detailed discussion of the work elements included in the construction.

1.6 PERFORMANCE CRITERIA

- A. Specialty VSC Contractor is completely responsible for the execution and performance of the soil improvement.
1. Geotechnical Engineer to review and approve that all treated ground has attained the required performance criteria in these specifications and required by field conditions.
- B. Construct VSC beneath the buildings and in the areas shown on the contract documents and Drawings to meet the minimum requirements listed below:
1. Minimum Area Replacement Ratio (ARR) of 11% throughout the building footprints.
 2. The minimum depth of VSCs should be 40 feet from existing grade.
 3. Minimum lateral limit of VSCs is 20ft beyond proposed building footprint.
 4. Add additional row(s) of VSCs as shown on drawings where stone columns cannot extend out because of utilities or structures.

- C. The average post-treatment liquefaction induced settlement is not to exceed 1 inch.
- D. The average static settlement should be less than 1/2 inch.
- E. The post construction differential settlement (static+seismic) shall be less than 3/4" in 40ft.
- F. Allowable bearing capacity for the foundation elements should be 4,000 psf.
- G. Following VSC improvement, complete four (4) post CPT sounding within the treatment area as located by and under the supervision of the Engineer.
 - 1. Locate CPTs at the center of the grid of 4 or 3 columns.
 - 2. Terminate each CPT at no less than 30 feet below the ground.
 - 3. Complete the CPTs no earlier than 5 calendar days following VSC installation.
- H. Submit calculations by the Specialty VSC Contractor to show the requirements of all the Performance Criteria specified herein have been satisfactorily achieved.
 - 1. Analytical techniques used in the calculations are to be based on widely-accepted industry practices such as that provided in, but not limited to, the Standards and Reference section of this Specification.
 - 2. The Engineer to review all calculations prepared by the Specialty VSC Contractor.
- I. Engineer (Paid by Owner) to employ the specialty subcontractor to perform the CPT in accordance with ASTM D3441.
- J. If any CPT probe does not meet the acceptance criteria specified in this Section, provide an additional two (2) CPT probes by the Specialty VSC Contractor in the vicinity of the failed test; as approved by the Engineer.
- K. If the Performance Criteria are not met, the Specialty VSC Contractor is to install additional VSC and perform additional CPT verification testing in order to meet the Performance Criteria at no additional cost to the Owner.

1.7 QUALITY ASSURANCE

- A. Required areas of treatment with VSC ground improvement are shown on the contract Drawings.
- B. The Field Quality Control Representative (FQCR) can be contractor's employee, but is required to be approved by Engineer. The FQCR may be the Superintendent or Field Engineer.
- C. The FQCR:
 - 1. Monitor the installation of VSC to verify that the production VSC installation methods are in accordance with the design submittal.
 - 2. Monitor Pre and Post Cone Penetration Testing of the VSC ground improvement.

3. Report any installation or material discrepancies to the Engineer and Construction Manager.

1.8 EXISTING UTILITIES

- A. The General Contractor/Construction manager shall field locate and verify the locations of all utilities prior to starting work. The General Contractor shall notify the VSC Contractor, Engineer, and Owner's Project Manager of any utility locations that may be impacted and may require relocation.

PART 2 PRODUCTS

2.1 STONE BACKFILL

- A. Stone backfill (aka gravel, aggregate, or crushed rock) to be used in the VSC shall consist of hard, durable, clean, crushed rock or crushed concrete, free of vegetable matter, steel, and other deleterious substances.
 1. Stone gradation to conform to the following requirements:

Sieve Size	Percent Passing
2 inch	100
1 inch	90-100
1/2 inch	5-80
No. 4	0-5

PART 3 EXECUTION

3.1 EXISTING PROPERTY CONDITION SURVEY

- A. Inspect adjacent buildings, structures, and utilities within 15 feet of the VSC improvement area for pre-construction conditions. This work shall include a photo survey, elevation survey, and crack/damage survey.
- B. If VSC vibrations cause any damage or movement of the adjacent buildings, structures, and utilities within 15 feet of the work, the following actions are to be taken:
 1. Notify Engineer immediately, and;
 2. Stop the work in the area, and;
 3. Specialty VSC Contractor to propose remedial measures to conclude the work in the area, which require approval by the Engineer prior to continuing the work in the affected area.

3.2 BUILDING PAD PREPARATION AND SPOILS HAUL OFF

- A. Site Contractor to prepare the building pad to a stable condition to support a 150-ton crane or vibro rig and heavy rubber-tired loader equipment.
- B. Perform VSC ground improvement following clearing and grubbing of the project site or building pad.

- C. Grading, compaction, and certification of the building pad to be performed by the Grading Contractor in accordance with the project manual and geotechnical requirements.
- D. Stock pile spoils generated by VSC operation for haul off or on site use by Grading Contractor.

3.3 VSC CONSTRUCTION

- A. The Specialty VSC Contractor to determine the method of VSC treatment and construction procedures, the specific equipment to be used, and the size and spacing of the VSC elements to achieve the Performance Criteria outlined in this Specification Section with the minimum requirements stated above. Such procedures and related information are subject to review by the Geotechnical Engineer during the submittal phase.
- B. Utilize offset rows, generally forming an equilateral triangular array of VSC for layout.
- C. Tolerance: Locate all VSC within 6 inches of the plan positions shown on the approved shop drawings.
- D. Construct VSC in maximum stone lift thickness of 24 inches. Redrive each lift through with the vibrator/mandrel to achieve the increased density in the soil.
- E. Where an unforeseen obstruction is encountered below the ground, inform the Engineer immediately. Should any obstruction be encountered during installation of VSC work, the Construction Manager is responsible for removing such obstruction; alternatively, relocate or abandon the VSC, as approved by the Engineer.

3.4 TEST SECTIONS

- A. Prior to VSC production work, the Specialty VSC Contractor to install one (1) VSC test section within production areas approved by the Engineer with at least sixteen(16) VSC elements.
- B. The Specialty VSC Contractor to propose a test program for the Engineer's approval.
- C. The method of installation is to be monitored and recorded by the FQCR and includes the bottom depth of the vibrator, the average volume of rock placed into VSC, and total VSC installation time.
- D. Test VSC test section for increased density by CPT no less than 5 calendar days after test section installation to confirm the performance criteria outlined in these specifications.
- E. The Specialty VSC Contractor to employ the specialty testing subcontractor to perform the CPT in accordance with ASTM D3441.
- F. Specialty VSC Contractor can go into production at its risk after performing the test section. All additional work required because of failing test section shall be responsible by VSC Contractor.

3.5 QUALITY CONTROL

A. VSC Inspections

1. Perform all VSC operations under the inspection of the FQCR.
2. Specialty VSC Contractor and the FQCR are to provide the monitoring and logging of VSC operations for production work.
3. The FQCR will provide site inspection to evaluate the performance of the VSC work.
 - a. Inspection may include: Recording of pre-drill hole depth, observance of the Specialty VSC Contractor's procedures, and recording of compaction energy information.

B. Construction Records: Specialty Geotechnical Contractor to keep written, daily records of the VSC treatment completed and shall submit signed copies of the records to the General Contractor and Engineer within two working days. The records shall show:

1. VSC identification number and date of installation for each VSC.
2. Elevation of the top and bottom of each VSC.
3. The average volume of stone in cubic feet placed in each VSC.
4. Average time of driving and raising of vibrator/mandrel per lift of stone.
5. Vibrator power consumption during penetration and compaction per 24 inches of VSC.
6. Total time to install each VSC.
7. Detailed documentation of obstruction, delays, and any unusual ground conditions.

END OF SECTION 316610

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DIVISION 32

EXTERIOR IMPROVEMENTS

LPA
PROJECT NO. 30647
05/23/2025

SECTION 320190 - LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish all labor, material, equipment and services required to maintain landscape in a healthy growing condition and in a neat and attractive appearance throughout the maintenance period.

1.2 RELATED REQUIREMENTS

- A. Division 32 Section Landscape Irrigation
- B. Division 32 Section Landscape Work

1.3 QUALITY ASSURANCE

- A. The Maintenance Contractor shall be experienced in horticulture and landscape maintenance, practices and techniques, and shall provide sufficient number of workers with adequate equipment to perform the work during the maintenance period.

1.4 MAINTENANCE PERIOD

- A. Continuously maintain the entire project area during the progress of the work and during the ninety (90) calendar-day maintenance period until final acceptance of the project by the Landscape Architect,
 - 1. Maintenance Period begins after all punchlist and corrective items have been accepted by the Landscape Architect and owner.
- B. Maintenance period shall not start until all punch list items are addressed, when all elements of construction, planting and irrigation for the entire project are in accordance with Plans and Specifications. A prime requirement is that all lawn and landscape areas shall be planted and that all lawn areas shall show an even, healthy stand of grass seedlings which shall have been mown twice. If such criteria are met to the satisfaction of the Landscape Architect, a written notification shall be issued to establish the effective beginning date of maintenance period.
- C. Any day of improper maintenance, as determined by the Landscape Architect, shall not be credited as an acceptable maintenance period day. The maintenance period shall be extended on a daily basis if the work is not in accordance to the Plans and Specifications. Project shall not be segmented into maintenance areas or phases, unless authorization of the Landscape Architect is obtained.
- D. Maintenance shall continue beyond the ninety (90) day maintenance period, as required, until final acceptance is given by the Landscape Architect.
- E. Contractor shall provide protection to the project site during the maintenance period.

- F. A phased maintenance period will not be accepted.

1.5 GUARANTEE AND REPLACEMENT

- A. Guarantee: All plant material and other materials installed under the Contract shall be guaranteed against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are as follows:
1. Trees, vines, and shrubs: One Year
 2. Groundcover and Turf: One year.
- B. Replacement: Any materials found to be dead, missing, declining or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect or owner. All replacement materials and installations shall comply with the Plans and Specifications. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the owner that security on this site needs to be intensified.
- C. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the owner shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

1.6 OBSERVATION SCHEDULE

- A. Normal progress observations shall be requested by the Contractor from the Landscape Architect as per observations listed in specifications Division 32 Section "Landscape Work."

1.7 FINAL ACCEPTANCE OF THE PROJECT

- A. Upon completion of all project work, including maintenance period, the Landscape Architect will, upon proper written request, make an observation to determine final project acceptability. Provide minimum a 14 business day notice for final observation.
- B. Where observed work does not comply with the Plans and Specifications, replace rejected work and continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable. All replacement materials and installations shall be in accordance with the Plans and Specifications. Remove rejected work and materials immediately from project. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings and close out documents in accordance with the Plans and Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials used shall either conform to Specifications in other sections or shall otherwise be acceptable to the Landscape Architect. The Landscape Architect shall be given a monthly record of all herbicides, insecticides and disease control chemicals used and irrigation scheduled. The amendments listed herein are for Bidding purposes only. The final amendment types and rates shall be determined by the Agronomic Soils Test.
- B. Turf maintenance fertilizer: shall be "Best Turf Supreme 16-6-8":
 - 1. 16% nitrogen
 - 2. 6% phosphoric acid
 - 3. 8% potash
- C. Slow Release maintenance fertilizer: shall be "Best Superturf 25-5-5 with Polyon" and shall consist of the following percents by weight:
 - 1. 25% nitrogen
 - 2. 5% phosphoric acid
 - 3. 5% potash

PART 3 - EXECUTION

3.1 GENERAL MAINTENANCE

- A. General: Proper maintenance, including watering, weeding, mowing, edging, fertilization, rolling of turf, replacement and infill of mulch replacement of jute mesh, infill of settled areas, repairing and protection shall be required until entire project is finally accepted, but in any event for a period of not less than the specified maintenance period after planting.
- B. Watering: Thoroughly water to insure vigorous and healthy growth until work is accepted. Water in a manner to prevent erosion due to application of excessive quantities of water. When hand watering use a water wand to break the water force. Supplemental hand water as required to maintain and encourage the proper growth of new and existing plant material.
- C. Weeding:
 - 1. Keep plant basins, turf areas and areas between plants free of weeds. Control weeds with pre-emergent herbicides. If weeds develop, use legally approved herbicides and hand remove. Avoid frequent soil cultivation that destroys shallow roots. Weeding also shall be included in all paved areas including public or private sidewalks.
 - 2. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.
 - 3. Apply a final application of pre-emergent herbicide at the end of the maintenance period, just prior to final acceptance.

- D. Tree basins in turf areas: Remove turf from around each tree to create a 4'- 0" diameter basin depending on tree size.
- E. Pruning
 - 1. Trees: Prune trees to select and develop permanent scaffold branches; to eliminate narrow V-shaped branch forks that lack strength; to reduce toppling and wind damage by thinning out crowns; to maintain a natural appearance and to balance crown with roots. All trees shall be maintained and pruned in accordance with the accepted practices of the American Society of Consulting Arborists (ASCA). Prune only as directed by the Registered Consulting Arborists and Landscape Architect.
 - 2. Shrubs: Same objectives as for trees. Shrubs shall not be clipped into balled or boxed forms unless such is required by the landscape plans. All pruning cuts shall be made to lateral branches, buds or flush with the trunk. Stubbing and heading shall not be permitted.
 - 3. Only skilled workers shall perform pruning work in accordance with standard horticultural pruning practices. Remove from the project all pruned branches and material. Remove and replace any plant material excessively pruned or malformed resulting from improper pruning practices at no additional costs to the owner.
 - 4. Improperly pruned plant material as determined by the Landscape Architect is to be replaced at no cost to the owner.
- F. Staking and Guys: Stakes and guys shall remain in place through the guarantee period and shall be inspected and adjusted to prevent rubbing that causes bark wounds. Remove nursery stake from all trees that are staked with lodgepole stakes per specifications. Provide supplemental staking or guying as required during high wind events to prevent damage to trees. Any damaged tree caused by high winds must be replaced by the contractor at no cost to the owner.
- G. Insect, Animal, Rodent and Disease Control: Maintain proper control with legally approved materials as required as part of the Contract.
- H. Protection: The Contractor shall maintain protection of the planted areas. Damaged areas shall be repaired or replaced at the Contractor's expense.
- I. Trash: Remove trash weekly in all planted areas, pedestrian walkways and parking areas. Maintain all areas free of trash, clippings, and debris at all times.
- J. Replacement: As per Guarantee and Replacement Specifications of this Section.
- K. Fertilization: Fertilize all planting areas, during and just prior to end of maintenance period with the slow release maintenance fertilizer as indicated in the agronomic soils report.
- L. Watering: Planting areas shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy plant material.
 - 1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

3.2 LAWN AND TURF MAINTENANCE

A. Mowing and Edging

1. Initial mowing of turf will commence when the grass has reached a height of two and one-half (2-1/2) inches. The height of cut will be two (2) inches. After initial establishment maintain Bermuda and creeping grasses at 1½" and fescues or rye grass at 2". Mowing will be at least every 4-6 days for the second through fifth cuttings, and at least once per week after that for fescue. Bermuda grass is to be mowed minimum twice a week. Bent grass is to be mowed daily. Turf must be well established and free of bare spots and weeds to the satisfaction of the Landscape Architect prior to final acceptance.
2. Excess grass clippings shall be picked up and removed from the site and premises. Let turf areas dry out enough so that mower wheels do not skid, tear or mark the lawn. Edges shall be trimmed at 90 degrees to pavement, at least weekly or as needed for neat appearance. Clippings shall be removed from paved and planting areas, etc. and disposed of from the site.

B. Watering: Lawns shall be watered at such frequency as weather conditions require to replenish soil moisture below root zone and to establish healthy strands of grass.

1. Contractor is responsible for water audits and payment of any local penalties by local water districts at no additional cost to the Owner.

C. Disease control: Control turf diseases throughout the maintenance period with legally approved fungicides and herbicides. Replace any damaged or infected grass.

D. Weed Control:

1. Control broad leaf weeds with selective, legally approved herbicides throughout maintenance period.
2. A final application of selective herbicide shall be applied at the end of the landscape maintenance period, acceptance, just prior to final acceptance.
3. Hand weed as required in addition to the application of weed control herbicides and pre-emergent to maintain all areas free of weeds including turf species other than the specified species. Periodic or predetermined weeding schedules may not be adequate and should be supplemented.

E. Fertilization:

1. During maintenance period an application of turf maintenance fertilizer, as specified, shall be made at thirty (30) day intervals from the date of maintenance period start at a rate of five (5) pounds per 1,000 square feet, and as required by the agronomic soils report.
2. Final application (just prior to final acceptance) shall be made with the slow-release maintenance fertilizer as required by the agronomic soils report.

3. Replacement: At conclusion of maintenance period a final observation of lawn and turf areas shall be made. Remove diseased areas and unhealthy strands of grass from the site; do not bury into the soil. Replant areas with material and in a manner as specified on the Plans and Specifications at no additional cost to the Owner. All grass is to be fully grown with 100% coverage with a suitable thatch layer prior to turnover and final acceptance.
- F. Arborist: Provide a written report and recommendations as required by the landscape architect if any plant material is in the sole opinion of the landscape architect, declining, stressed, infested, or otherwise not growing at the anticipated growth rate. The report is to include Agronomic Soils Test Data and recommendations and be provided at no cost to the owner.

3.3 IRRIGATION SYSTEM

- A. System Observation: The Contractor shall check all systems for proper operation. Lateral lines shall be flushed out after removing the last sprinkler head or two at each end of the lateral. All heads are to be adjusted as necessary for unimpeded head to head coverage.
- B. Valves: Contractor shall set, and verify that all pressure regulating valves to the operating pressure specified on the drawings.
- C. Controllers: Set and program automatic controllers for seasonal water requirements. Give the Owner's Representative instructions on how to turn off system in case of emergency.
- D. If the irrigation system is designed and specified to be operable from a central irrigation computer controller located off site, or a standard controller on site. The contractor shall demonstrate to Landscape Architect, Owner's Representative and future maintenance contractor that the central irrigation system is fully installed and operational from this off site control system as described and specified. Contractor shall make all adjustments as necessary to insure this operation prior to final acceptance.
- E. Contractor shall set up and coordinate training for the Maintenance Contractor (Provider) on the irrigation controller, and pump with the manufactures representative. Maintenance period shall not end, and the project will not be accepted until this training has been completed.
- F. Repairs: Repair all damages to irrigation system at the Contractor's expense. Repairs shall be made within twenty-four (24) hours or sooner to prevent damage to site improvements.

3.4 CLEANING

- A. During maintenance work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, fertilizer, amendments and / or other material from landscape planting and/or maintenance period.
- B. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks on surfaces caused by maintenance or construction vehicles, prior to final acceptance.

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END OF SECTION 320190

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SECTION 321123 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course.

1.2 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of site for base course.
- B. Section 321216 - Asphalt Paving: Finish and binder asphalt courses.
- C. Section 321313 - Concrete Paving: Finish concrete surface course.
- D. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- E. Project Geotechnical Report.

1.3 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses; 2017 (Reapproved 2021).
- B. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- D. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- E. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- F. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- G. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2015.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

- I. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
- J. Standard Specifications for Public Works Construction (Greenbook); current edition.
- K. California State Department of Transportation Standard Specifications (Caltrans); current edition.
- L. Project Geotechnical Report.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Materials Sources: Submit name of imported materials source, location, and gradation of the material.
- C. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- D. Compaction Density Test Reports.
- E. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - 2. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 3. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MATERIALS

- A. Aggregate Base: Crushed aggregate base, conforming to Greenbook, Section 200-2.2.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA.

2.3 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, testing of samples for compliance will be provided before delivery to site.
- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

- A. Spread aggregate over prepared substrate to a total compacted thickness as indicated on plans.

- B. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- C. Level and contour surfaces to elevations and gradients indicated.
- D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- E. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- G. Apply herbicide per manufacturer requirements.

3.4 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation From Design Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for general requirements for field inspection and testing.
- B. Compaction density testing will be performed on compacted aggregate base course in accordance with ASTM D1556, ASTM D2167, or ASTM D6938.
- C. Results will be evaluated in relation to compaction curve determined by testing uncompacted material in accordance with AASHTO T 180, ASTM D698 ("standard Proctor"), or ASTM D1557 ("modified Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade.

3.6 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION 321123

SECTION 321216 - ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.
- C. Surface sealer.

1.2 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of site for paving and base.
- B. Section 321123 - Aggregate Base Courses: Aggregate base course.
- C. Section 321313 - Concrete Paving: Concrete substrate.
- D. Section 321313 - Concrete Paving: Concrete curbs.
- E. Section 321723 - Pavement Markings
- F. Project Geotechnical Report.

1.3 REFERENCE STANDARDS

- A. AI MS-2 - Asphalt Mix Design Methods; 2015.
- B. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- D. ASTM D3549 Standard Test Method for Thickness of Height of Compacted Asphalt Mixture Specimens (2018).
- E. ASTM D2950 Standard Test Method of Density of Bituminous Concrete in Place by Nuclear Methods (2020).
- F. Standard Specifications for Public Works Construction (SSPWC, Greenbook); current edition.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Standard Specifications for Public Works Construction (SSPWC) and the California Department of Transportation (Caltrans), latest editions and supplements for asphalt paving work.
- B. Obtain materials from same source throughout.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1.6 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 50 degrees Fahrenheit and rising, or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphalt Concrete: Greenbook, Section 203-6.
- B. Aggregate Base Course: Section 321123.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Parking lots including drive aisles and parking spaces:
 - 1. Wearing course: III-C3 PG 64-10 per SPPWC Section 203-6.5.
 - 2. Base course: III-B3 PG 64-10 per SPPWC Section 203-6.5.
- B. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.3 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 AGGREGATE BASE COURSE

- A. See Section 321123.

3.3 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with SPPWC (Greenbook), Section 302-5.4.
- B. Apply tack coat to existing pavement including planed surfaces, between hot mix asphalt layers, and to vertical surfaces of curbs, gutters, construction joints and milled pavements.

3.4 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install work in accordance with SPPWC (Greenbook) 302-5.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place to a maximum thickness per SSPWC 302-5.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.5 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Install work in accordance with SPPWC (Greenbook) 302-5.
- B. Place asphalt base course within 24 hours of applying primer or tack coat.
- C. No pavement course shall be less than 1 1/2 inches in compacted thickness. If finish pavement thickness is 3 inches or less it shall be laid as single course.
- D. No pavement course shall be more than 4 inches in compacted thickness.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.6 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.

- C. Variation from True Elevation: Within 1/2 inch.

3.7 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for quality control.
- B. Provide final surfaces of uniform texture, conforming to required grades and cross sections.
1. Test in-place asphalt concrete courses for compliance with requirement for density, thickness, and surface smoothness.
 - a. Density:
 - 1) Field test density of compacted asphalt surface course shall be determined by a properly calibrated nuclear test gage in accordance with ASTM D2950.
 - b. Thickness:
 - 1) Thickness of compacted paving shall conform to ASTM D3549 based on core test.
 - 2) In-place compacted thicknessess shall conform to the dimensions indicated on the contract drawings. Variation from indicated thicknesses shall not exceed plus-or-minus 1/4-inch.
- C. Flood Testing
1. Flood Test: Before acceptance, all pavements in the presence of the project inspector shall be water tested to ensure proper drainage. The contractor shall provide water for this purpose. The flooding shall be conducted with a water tank truck. Depressions where the water ponds to a depth of more than 1/8-inch shall be filled or the slope corrected to provide proper drainage. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible. No standing water shall remain 1-hour after test.

3.8 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Driveways.
- B. Roadways.
- C. Parking lots.
- D. Curbs and gutters.
- E. Walks.
- F. Stairs and ramps.
- G. Mow strips.
- H. Wheel stops.
- I. Pavement marking paint.

1.2 RELATED REQUIREMENTS

- A. Division 03 Section Cast-in-Place Concrete
- B. Division 05 Section Metal Fabrications
- C. Division 05 Section Pipe and Tube Railings.
- D. Division 05 Section Decorative Metal Railings
- E. Division 32 Section Architectural Site Concrete
- F. Division 32 Section Concrete Paving Joint Sealants
- G. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover SheetDivision 32 Section Decorative Metal Fences and Gates
- H. Project Geotechnical Report

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone for colored concrete. Portland cement for natural grey concrete in combination with Fly ash, subject to compliance with requirements.

1.4 PREINSTALLATION CONFERENCE

- A. Conduct conference at Project site two weeks prior to start of work of this section. Required attendance of all affected installers.
 - 1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - 2. Concrete mixture design
 - 3. Testing and inspection procedures.
 - 4. Concrete finishes and finishing.
 - 5. Cold- and hot-weather concreting procedures.
 - 6. Curing procedures.
 - 7. Construction joints.
 - 8. Forms and form-removal limitations.
 - 9. Reinforcement accessory installation.
 - 10. Concrete repair procedures.
 - 11. Protection of cast-in-place architectural site concrete.
 - 12. Review special testing and inspection procedures.
 - 13. Placement sequence and schedule.
 - 14. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Concrete paving subcontractor.
 - c. Architect's Representative
 - d. Provide meeting minutes for pre-installation conference

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, etc.: Indicate compatibility with other materials used.
 - 2. Stenciling material
- B. Sustainable Materials - LEED
 - 1. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - a. 018113 Sustainable Design Requirements
 - 2. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - a. Pre-consumer and Post-consumer Recycled Content

- 1) For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - (a) Refer to Section 018113 for documentation requirements specific to this criteria.
 - 2) Preference is given to products with maximum amount possible of post-consumer recycled content by weight
- C. Samples for Initial Selection: For each type of product, finish, ingredient, or admixture requiring color selection.
1. Submit full range of manufacturer's standard and custom range of colors and products for review and selection. Provide custom colors on samples as required. Upon selection of color, submit 12"x12" sample of material in the specified color finish for review by Landscape Architect in addition to the specified mock ups.
- D. Design Mixtures: Submit proposed mix designs and test data for each class of concrete and for each method of placement.
1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1903.
 2. Mix designs shall be prepared, stamped and signed by a structural or civil engineer registered in the State of California.
 - a. Mix designs shall be reviewed by the Architect (AOR) and Structural Engineer of Record (SEOR).
 3. Identify for each mix design submitted the method by which proportions have been selected.
 - a. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength f'_c results. Provide gross weight and yield per cubic yard of trial mixes.
 - b. Indicate quantity of each ingredient per cubic yard of concrete and percentages.
 - c. Indicate type and quantity of admixtures proposed or required.
 - d. Indicate water to cement ratio by weight.
 - e. Measured slump.
 - f. Measured air content.
 - g. Provide shrinkage test results.
 4. Multiple mix designs or multiple manufacturers shall not be permitted for the same application.
- E. Provide maximum 5% fly ash for non-colored concrete mix designs as Portland cement replacement.
- F. Colored Concrete mix designs should contain no fly ash.

- G. Submit proposed alternate design mixtures for review by the Architect and SEOR when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- H. 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. Shop drawings should include details such as reveals, recessed lights, handrails, or other elements requiring steel coordination.
 - 1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
 - 2. Comply with ACI 315, part B and CRSI requirements.
- I. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete if different than layout indicated on plans.
 - 1. Location of construction joints are subject to approval of the Architect.
 - 2. All form seams are to align with construction joints or reveals.
- J. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- K. Qualification Data: For qualified ready-mix concrete manufacturer (batch plant) and installer of detectable warnings.
- L. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.
- M. Material Certificates: For the following, submit manufacturer data, test results, and technical information for aggregate, sand and cement, submit ½ cubic foot physical sample. For sealant submit manufacturer color standard and custom palette together with physical samples:
 - 1. Cementitious materials.
 - 2. Aggregates and sand.
 - 3. Steel reinforcement and reinforcement accessories.
 - 4. Fiber reinforcement.
 - 5. Admixtures.
 - 6. Curing compounds.
 - 7. Applied finish materials.
 - 8. Bonding agent and epoxy adhesives.
 - 9. Joint fillers.
 - 10. Sealer
 - 11. Sealant.
 - 12. Pigments.

- N. Material Test Reports: For each of the following:
 - 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- O. Field quality-control reports.
 - 1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.
- P. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with CBC Chapter 19.
- B. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
- C. Comply with requirements of local, State and other authorities having jurisdiction for work performed within public right-of ways.
- D. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.(Plans and specifications)
 - 1. ACI 301, "Specifications for Structural Concrete".
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
 - 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
 - 4. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
 - 5. ACI 305R, "Hot Weather Concreting".
 - 6. ACI 306.1, "Standard Specification for Cold Weather Concreting".
 - 7. ACI 318, "Building Code Requirements for Structural Concrete".
 - 8. ACI 347, "Guide to Formwork for Concrete".
 - 9. ACI SP-66, "ACI Detailing Manual".
 - 10. CRSI, "Manual of Standard Practice".
 - 11. CRSI, "Placing Reinforcing Bars".
- E. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

- F. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance.
- G. Welding Qualifications: Comply with CBC Chapter 17.
 - 1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
 - 2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- H. 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.
- I. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- J. ACI Publications: Comply with ACI 301 unless otherwise indicated.
- K. Mockups: Before casting concrete paving, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints (including expansion and saw cut joints), surface finish, texture, color tolerances, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - a. Paving Modules: Construct at least one 4 ft. x 4 ft. mockup of each color, finish, and mix design of special paving module, including stenciled areas, banding and curbs
 - b. Retarder Finishes: Mock ups shall clearly demonstrate an even finish. No blotchy or light areas.
 - c. Stairs: Construct minimum 2 risers and treads X 4' long with nosing grooves and stained color within groves for each color and finish specified.
 - d. Mow Strip: minimum 6' long for each specified width and color.
 - 2. Build mockups full-size, matching site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, edges, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated including multiple pour conditions. Mockups should be provided for each finish, color, joint and detail specified.
 - 3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
 - 4. Demonstrate curing, cleaning, and protecting of cast-in-place concrete paving, finishes, and contraction and expansion joints, as applicable.
 - 5. Mockup Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete and paving.

- a. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
 - b. The Architect may require modifications to mockups to obtain acceptable results.
 - c. The Architect may require modifications to mockup repairs to obtain acceptable results.
 - d. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups maybe required.
 - e. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
6. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mockup onsite for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. prior to Project Completion. If sufficient permanent concrete paving work has been completed, Contractor may submit a written request to Architect to transfer quality control for concrete paving from the accepted mockups to one or more designated portions of the permanent work.
7. Provide written meeting minutes for each mock up review indicating items reviewed, approvals, rejections, connections, or other action items.

1.7 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending, damage, and rust.
1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
 2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
 3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 FORMS

- A. Formwork: / Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth surfaces.

1. Set forms to alignment, grade and required dimensions. Formwork shall not deviate more than 1/4 inch from required vertical positions and 1/4 inch from required horizontal positions. Exposed Surfaces: Provide faced plywood panels complying with, or equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints. Provide Medium-Density Overlay (MDO) panels or high density overlay (HDO) panels, with mill-applied release agent and edge sealant. Provide one of the following panels, or comparable substituted product:
 - a. Olympic Panel Products, "B-Matte 333 MDO Concrete Form." Overlay Color: Brown.
 - b. Pacific Laminate Products, "ProFace MDO." Overlay Color: Black.
 - c. Sylvan Products, LLC, "Armor Ply MDO" Overlay Color: Brown.
 2. Hold forms rigidly in place by stakes, clamps, spreaders, and braces at 3 feet on centers, and where required to ensure rigidity.
 3. 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.
 4. Place joint filler or backer rod on vertical surfaces in contact with concrete paving.
 5. Benders or thin plank forms may be used on curves, grade changes, or curb returns. Back forms for curb returns may be made of 1/2-inch thick benders cleated together for full depth of the curb.
 6. Keep forms in place until concrete is sufficiently hard to prevent damage to concrete.
 7. Reuse of Forms:
 - a. Do not reuse forms if there is any evidence of surface wear or defect which would impair quality of surface or edge.
 - b. Thoroughly clean and properly coat forms before reuse.
 - c. Do not use forms from previous projects.
 8. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.
- B. Curved Work: Kerf back of plywood form-facing panels, or use accepted flexible or curved forms for curved work with a radius of 100 feet or less.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
 2. Form-release agents shall be non-staining and can cause no visual effect to the finish.
 3. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

- A. Recycled Content: Provide steel reinforcement with an average recycled content of steel so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 60 percent.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- F. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- G. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.
 - 1. Provide two-component "Speed Dowel System" manufactured by Greenstreak.
- H. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- I. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- J. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
- K. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- L. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- M. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150, Type II/V, Type I/II or Type IV, gray, unless white cement is required to achieve colors indicated.
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Fly Ash: none accepted for color concrete mix.
- B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
 1. Comply with CBC section 1903.
 2. Maximum Coarse-Aggregate Size: 3/8 inch nominal.
 - a. Source: Reliance, Vulcan, San Gabriel, or Carrol Canyon
 - b. Hard rock mix; no pea gravel will be accepted.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - a. Source: Reliance, Foster, Corona
 - b. Color to be white to light no dark material.
- C. Water: Potable and complying with ASTM C 94/C 94M.
- D. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
 1. Products: Subject to compliance with requirements, provide the following(as required):
 - a. Meet ASTM C494 requirements
 - 1) Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
 - 2) Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
 - 3) Sika Corporation; Control 40.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete. Provide products with not more than 100g/L volatile organic content.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals, LLC; Confirm.
 - b. Conspec by Dayton Superior; Aquafilm.
 - c. Nox-Crete Products Group; MONOFILM.

- E. Clear, Waterborne, Membrane-Forming Curing Compound (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sinak Corporation; The Cure WCE or Lithium Cure 1000.
 - b. L. M. Scofield; Cureseal-W.
 - c. Butterfield Color; Clear Guard H2O.
- F. All curing materials should be dissipating without leaving a shiny, cloudy, or glossy finish. Curing material does not substitute requirement of a sealer.

2.5 HARDENERS AND SEALERS

- A. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate water-based lithium quartz materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide product with 0g/L volatile organic content.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sinak Corporation; Concrete Sealer HLQ 125.
 - b. L. M. Scofield; Cureseal-W.
 - c. L&M Construction Chemicals, Inc.; Seal Hard.

2.6 RELATED MATERIALS

- A. Joint Fillers:
 - 1. Deck-O-Foam polyethylene by W.R. Meadows. A closed cell expansion joint filler ASTM D 4819
 - 2. 1/4" thickness.
- B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. W. R. Meadows, Inc.; "Acry-Lok".
 - b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
 - c. Larsen Products Corp., "Weld-Crete".
- C. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, and for anchoring dowels to hardened concrete.

- D. 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 reveal specified.
 - 1. Provide W. R. Grace "Top-Cast".

2.7 PAVEMENT MARKINGS

- A. Color: As indicated.
- B. Pavement-Marking Paint: MPI #97 Latex Traffic Marking Paint.
 - 1. Color: White, green, unless otherwise indicated. Use for non-accessible striping, directional arrows, numbering, and lettering.
 - 2. Accessibility Color: Paint accessibility lines and markings blue color equal to Color No. 15090 per Federal Specification 595C.

2.8 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 5-1/2 to 6 inches high by 7 inches wide by 48 inches long at singles stalls and 72 inches long at shared stalls. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel or rebar, 1/2 inch in diameter, 18-inch minimum length.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. Proportioning:
 - a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
 - b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
 - 1) Float/Broom Finish: Coarse aggregate 50 percent-50 percent fine aggregate.
 - 2) Retarder finish: Coarse aggregate 40 percent, fine aggregate 60 percent.
 - c. Total water content shall not exceed 35 gallons per cubic yard of concrete.
 - d. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
 - e. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.

3. Prepare compressive strength data for both 7-day and 28-day strengths.
 - a. The 7-day compressive strength shall be at least 60 percent of the required 28- day strength.
 - b. The 28-day compressive strength shall be as indicated.
 - c. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 1. Typical Compressive Strength (28 Days): Provide the following minimum compressive strength (28 days) for concrete paving unless otherwise indicated: 3000 psi.
 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
 3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
 - a. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.
- C. Air Content, Exterior Exposed Concrete: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per CBC Figure 1904.2.2:
 1. Provide air entrainment of 6.0 percent, plus or minus 1.5 percent at point of delivery for 1-inch and 3/4-inch nominal maximum aggregate size, if required unless indicated otherwise.
- D. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
- E. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- F. Chemical Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- G. Liquid Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M [or ASTM C 1116/C 1116M when fiber reinforcement is used]. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg. F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F (32 deg. C), reduce mixing and delivery time to 60 minutes.
- B. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving with heavy pneumatic-tired equipment 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. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Division 31 Section "Earth Moving."
- C. Proceed with concrete paving 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.
- C. Slope stair and step treads at not less than 1.0 percent and not more than 2.0 percent cross slope to drain.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation or expansion joint, and saw cut / 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. Isolation (Expansion) Expansion 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 20 feet maximum unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint and recess 1 inch from finish surface where no joint sealant is indicated.
 - 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 5. Break steel at expansion joints.
 - 6. Dowels- provide prefabricated 'speed dowel' assemblies.
- C. Saw Cut (Control) Joints: Form weakened-plane saw cut joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth plus 1/4 inch of the concrete thickness, as follows, and to match jointing of existing adjacent concrete paving:
 - 1. Continue steel reinforcement across sawcut joints unless otherwise indicated.
- D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch radius unless otherwise noted. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in. Notify other trades as necessary to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, and side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 deg. F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F (10 deg C) and not more than 80 deg. F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 305R (ACI 305R M) and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg. F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- N. Provide sand and base materials as indicated.

3.7 FLOAT/BROOM FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture. Required to meet slip coefficient requirement.
 3. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Sections 11B-302 and 11B-403.

3.8 RETARDER FINISHING(FINE AGGREGATE)

- A. Protect all surrounds from overspray of liquid materials, including, but not limited to, adjacent horizontal surfaces, windows, roofs, walkways, drives, and landscaping.
1. Apply surface protectant and /or plastic sheeting, sufficiently taped in place.
- B. Ensure to screed surface of concrete evenly to designated slope shown on approved civil grading plans.
- C. Prepare concrete for retarder finish as recommended by retarder manufacturer.

1. Consider using rolling tamper, jitterbug or rolling jitterbug to create a denser surface paste with no obstruction due to the appearance of coarse aggregate, allowing for a uniform sand texture.
 2. Screed or strike off the surface in two (2) directions using a wooden or metal straight edge to achieve the proper elevation in a sawing motion back and forth.
 3. Allow the bleed water to evaporate from the surface.
 4. Float concrete using a wooden hand/bull float.
 5. Float to a uniform appearance.
 6. Hand trowel or Fresno steel frowel to create tight dense smooth surface.(This could require 2 - 3 passes depending on mix design and/or desired finish to be achieved)
 7. Do not burnish the surface or allow the exposed sand surface to premanturely dry prior to the application of the surface retarder.
- D. Mix surface retarder thoroughly prior to each use.
- E. Apply surface retarder per manufacturers recommendations.
- F. Remove retarder per manufactures recommendations.

3.9 CONCRETE PROTECTION, CURING AND SEALING:

- 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 moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:
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, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
- F. Seal Concrete: Apply specified sealer in accordance with manufacturer's recommendations.
1. Apply full strength in two coats with airless sprayer at the manufacturer's recommended rate.
 2. After the first coat is completely dry, apply second coat at right angles to the first coat.

3.10 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117, the Americans with Disabilities Act, the CBC and as follows:
1. Elevation: 1/8 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/8 inch. Surface must properly drain.
 4. Surface Discontinuities: Maximum 1/4 inch, subject to further limitations of accessible routes.
 5. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 6. Lateral Alignment and Spacing of Dowels: 1/4 inch.
 7. Vertical Alignment of Dowels: 1/8 inch.
 8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/8 inch per 12 inches of dowel.
 9. Joint Spacing: 3 inches, except joint position shall be within 1/4 inch of objects in alignment with joint such as benches, light poles, pull boxes, etc.
 10. Sawcut Joint Depth: Plus 1/4 inch, no minus.
 11. Joint Width: Plus 1/16 inch, no minus.
- B. Stair Treads: Stair treads within a run shall be constructed equally and shall shed water away from the path of travel. Maximum tread slope down from riser to nosing in direction of travel: 1.0 percent, plus or minus 0.5 percent. Maximum tread cross-slope perpendicular to direction of travel: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.
- C. Ramps: Ramps shall shed water away from the path of travel. Maximum ramp slope in direction of travel: 8.33 percent. Maximum ramp cross-slope perpendicular to direction of travel: 1.8 percent, plus 0.2 percent, minus 1.0 percent or as required to shed water.

3.11 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils. Provide markings with a minimum width of 3 inches.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.
- E. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. **CBC Section 11B-208.3.1.**
- F. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. **CBC Section 11B-208.3.1.**
- G. Minimum number of required accessible parking spaces shall be provided in accordance with **CBC Table 11B-208.2** for each parking facility provided.
- H. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. **CBC Section 11B-208.3.1.**
- I. Accessible parking spaces and access aisles shall comply with **CBC Section 11B-502** and shall be dimensioned to the centerlines of the marked lines as follows:
 - 1. Parking spaces and access aisles shall be marked according to **CBC figures 11B-502.2, 11B-502.3, and 11B-502.3.3**. Their surfaces shall comply with **CBC Section 11B-302** and shall be at the same level with the slopes not steeper than 1:48 in any direction. **CBC Section 11B-502.4.**
 - 2. Parking spaces shall be 9'x18' minimum and van parking spaces shall be 12'x18' minimum with an adjacent access aisle of 5'x18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9'x18' minimum where the access aisle is 8'x18' minimum.
 - 3. Access aisles shall be marked by a blue painted borderline around their perimeter. The areas within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. **CBC Section 11B-502.3.3**

4. Access aisles (parking spaces as well- similar application) shall not overlap the vehicular way. **CBC Section 11B-502.3.4**
 5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. **CBC Section 11B-502.5**
- J. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with **CBC Section 11B-209 and 11B-503** as follows:
1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. **CBC Section 11B-503.4.**
 2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. **CBC Section 11B-503.3.**
 3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. **CBC Section 11B503.5.**

3.12 WHEEL STOPS

- A. Securely attach wheel stops to paving with not less than two #4 galvanized steel dowels or rebar, minimum 18 inches long, located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 20 cu. Yd., or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when it is 80 deg. F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Owner, Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.14 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, cracked, chipped, stained or defective or that does not comply with requirements in this Section as determined by Landscape Architect. 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 all but pedestrian traffic from paving for at least 28 days after placement. When construction traffic is permitted, maintain paving as clean as possible by providing adequate surface protection and by removing surface stains and spillage of materials as they occur.
 - 1. Rubber tire marks are unacceptable in the completed construction.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Project Completion inspections.
- E. Repair of damaged, defective or rejected concrete is not permitted. Remove all concrete from expansion joint to expansion joint or greater as required to provide a constant continuous finish.

3.15 FINAL CLEANING

- A. Remove all excess concrete, form materials, over pours, waste, etc., and legally dispose off-site.
- B. Provide a final acid and power wash for all concrete paving surfaces. Do not use any material that will affect the appearance of the concrete.
- C. All over pours in planting areas should be removed prior to landscape operations.
- D. Clean concrete paving to remove stains, markings, dust, and debris.

END OF SECTION 321313

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SECTION 321373 - PAVEMENT JOINT SEALERS

PART 1 - GENERAL

1.1 SECTION INCLUDES: RELATED DOCUMENTS

- A. Exterior joint sealant for non-traffic surfaces.

1.2 RELATED REQUIREMENTS

- A. Division 32 Section Concrete Paving.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in 1/2-inch- (13-mm-), and 1/4-inch (6.4-mm) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
- D. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- B. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
- C. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- D. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- E. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

- F. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multi-component materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
- B. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
- C. When joint substrates are wet or covered with frost.
- D. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
- E. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Landscape Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Multicomponent Pourable Urethane Sealant (Sealant #1):
 - 1. Available Products:
 - a. Bostik Findley; Chem-Calk 550.
 - b. Meadows, W. R., Inc.; Pourthane.
 - c. Pacific Polymers, Inc.; Elasto-Thane 227 Type I (Self Leveling).
 - d. Pecora Corporation; Urexpan NR-200.
 - e. Polymeric Systems Inc.; PSI-270SL.
 - f. Schnee-Morehead, Inc.; Permathane SM 7201.
 - g. Sika Corporation, Inc.; Sikaflex - 2c SL.
 - h. Sonneborn, Division of ChemRex Inc.; SL 2.
 - i. Tremco; THC-900/901.
 - j. Tremco; Vulkem 245.
 - 2. Type and Grade: M (multicomponent) and P (pourable).
 - 3. Class: 25.
 - 4. Use Related to Exposure: T (traffic).
 - 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
- D. Multicomponent Nonsag Urethane (Sealant #2):
 - 1. Available Products:
 - a. Pacific Polymers, Inc.; Elasto-Thane 227 High Shore Type II (Gun Grade).
 - b. Pecora Corporation; Dynatred.
 - c. Polymeric Systems Inc.; PSI-270.
 - 2. Type and Grade: M (multicomponent) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: T (traffic).
 - 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

- A. Primers: Product 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type 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 backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. 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 provided for each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.
- F. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

3.6 SCHEDULE

- A. Horizontal Joints, less than 5 percent slope; Sealant No. 1.
- B. Horizontal Joints, grades steeper than 5 percent; Sealant No. 2
- C. Vertical Joints; Sealant No. 2

END OF SECTION 321373

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SECTION 321413 - PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Detectable warning pavers.
- B. Sand setting bed.
- C. Sand joint filler.
- D. Polymeric sand joint filler.
- E. Aggregate fill.
- F. Topsoil filler.

1.2 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of subsoil for pavers.
- B. Section 321123 - Aggregate Base Courses: Aggregate subbase for pavers.
- C. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet
- D. Project Geotechnical Report

1.3 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- B. ASTM C936/C936M - Standard Specification for Solid Concrete Interlocking Paving Units; 2013.
- C. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping Purposes; 2013.

1.4 QUALITY ASSURANCE

- 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. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at work site.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide characteristics of paver unit, detectable warning pavers, dimensions, and special shapes.
- C. Samples: Submit two samples of each paver type, illustrating style, size, color range and surface texture of units being provided.
- D. Manufacturer's Installation Instructions: Indicate substrate requirements and installation methods.
- E. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
 1. Extra Pavers: 10 of each type and size.
- F. Sustainable Design Submittals
 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.6 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.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Sustainability performance requirements: For all permanently installed products and materials related to the work of this Section, provide products and materials that meet the Project's performance and LEED criteria as outlined below and described in detail in the following Sections:
 - 1. 018113 Sustainable Design Requirements
- B. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - a. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - b. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

- A. Interlocking Concrete Pavers:
 - 1. Tectura Designs, a division of Wausau Tile Inc: www.tecturadesigns.com/#sle.

2.3 MATERIALS

- A. Regional Materials: Provide concrete pavers that have been manufactured within 500 miles of Project site from aggregates[and cement] that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Interlocking Concrete Pavers: Hydraulically pressed concrete, configured for interlocking with adjacent units and complying with ASTM C936/C936M.
- C. Detectable Warning Pavers: Cast concrete with truncated domes, A-40 federal yellow color. Provide 12"x12"x2" manufactured by Wasau Tile, Inc. .
- D. Sand for Setting Bed: Clean washed natural sand or crushed stone, free from deleterious or foreign matter complying with gradation requirements of ASTM C33/C33M for fine aggregates.
 - 1. Do not use mason sand or sand conforming to ASTM C 144 for the bedding sand.
 - 2. Bedding Sand at vehicular use areas:
 - a. Sieve according to ASTM C 136.
 - b. Requirements for bedding sand at vehicular use areas shall conform to the grading requirements of ASTM C 33 with the modifications shown in table below.

Sieve Size	Percent Passing
3/8 inch (9.5mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85

No. 30 (0.600 mm)	25 to 60
No. 50 (0.300 mm)	10 to 30
No. 100 (0.150 mm)	2 to 10
No. 200 (0.075 mm)	0 to 1

- E. Sand for Joints: Fine washed sand with 70 to 100 percent passing No. 16 sieve and not more than 5 percent passing No. 200 sieve. ASTM C 144 ASTM C 144.

Sieve Size	Percent Passing
No. 4 (4.75 mm)	100
No. 8 (2.36 mm)	95 to 100
No. 16 (1.18 mm)	70 to 100
No. 30 (0.600 mm)	40 to 75
No. 50 (0.300 mm)	10 to 35
No. 100 (0.150 mm)	2 to 15
No. 200 (0.075 mm)	0 to 5

- F. Aggregate base for subbase: Refer to specification section 321123 Aggregate Base Courses.
1. Crushed Aggregate Base, thickness as noted in details.
 - a. Grading of aggregate per Greenbook specification section 200-2.
 2. Crush Miscellaneous Base, thickness as noted in details.
 - a. Grading of aggregate per Greenbook specification section 200-2.

2.4 ACCESSORIES

- A. Sealers:
1. Surebond SB-1300
- B. Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

PART 3 EXECUTION

3.1 EXAMINATION

- A. With the installer present, verify that substrate is level or to correct gradient, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this Section.
- B. Verify gradients and elevations of substrate are correct.
- C. Proceed with installation only after unstatifactory conditions have been corrected.

3.2 PREPARATION

- A. Where aggregate subbase is required, proof roll subgrade to identify soft pockets and areas of excess yielding. Proceed with precast concrete paver installation only after deficient subgrades have been corrected and ready to receive subbase and base courses for concrete pavers.
- B. Treat leveling course to retard plant growth.

3.3 EDGING INSTALLATION

- A. Install edging prior to placing unit pavers.

3.4 INSTALLATION OF SOLID PAVER UNITS

- A. Place geotextile over compacted base course/compacted subgrade.
 - 1. Overlap edges of geotextile by 12 inches minimum.
- B. Spread sand bedding evenly over prepared substrate surface to a maximum thickness of 1-1/2 inch.
- C. Dampen and roller compact sand to level and even surface.
- D. Screed and scarify top 1 inch to 1 1/2 inch of sand.
- E. Cut paver units at edges with masonry saw.
 - 1. Provide clean, sharp, unchipped edges.
 - 2. Cut units to provide pattern indicated and to fit adjoining work neatly.
 - 3. Use full units without cutting where possible.
 - 4. Hammer cutting is not acceptable.
- F. Place half units at edge and interruptions. Maintain tight joints.
- G. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- H. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- I. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.
- J. Sprinkle sand over surface and sweep into joints. Moisten joints and recover with additional sand until firm joints are achieved. Remove excess sand.

- K. Spread polymeric sand uniformly over surface. Use a push broom to fill joints and remove excess while not sweeping long distances. Sweep all excess with a fine bristle brush and remove residues with a leaf blower.
- L. Tamp and level paver units with mechanical vibrator until units are firmly bedded, level, and to correct elevation and gradients. Do not tamp unrestrained edges.
 - 1. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
 - 2. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
 - 3. Before ending each day's work, compact installed concrete pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
 - 4. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
 - 5. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- M. Spread dry joint sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- N. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- O. Tolerances: Do not exceed[1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and] 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- P. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- Q. Repeat joint-filling process 30 days later.

3.5 CLEANING

- A. Do not clean pavers until pavers and mortar are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.

- E. Broom clean paving surfaces. Dispose of excess sand.

3.6 PROTECTION

- A. Do not permit traffic over unprotected paver surface.
- B. Protect paver surface with sheets of plywood.
- C. Do not permit traffic for 48 hours after pavement placement.

3.7 REPAIRING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321413

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SECTION 321416 - BRICK UNIT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Brick Pavers.
- B. Sand Materials.
- C. Cementitious Materials.
- D. Accessories.
- E. Mixes.

1.2 RELATED REQUIREMENTS

- A. Section 312323 - Fill: Compacted subbase preparation.
- B. Section 321313 - Concrete Paving: Concrete paving for brick paver base; concrete curbs.
- C. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2015.
- C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
- D. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019.
- E. ASTM C902 - Standard Specification for Pedestrian and Light Traffic Paving Brick; 2013.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2002 (Reapproved 2013).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittals procedures.

- B. Product Data: Provide data on characteristics of paver unit, curbs and border, special shapes, dimensions, setting and grouting materials.
- C. Shop Drawings: Indicate on shop drawings, layout of pavers, special design layout, layout of curbs and borders, dimensions of paved areas, control jointing, elevations, and affected adjacent construction.
- D. Samples: Submit two sample paver, curb, and border units illustrating color, surface finish, and texture.
- E. Sustainable Design Submittals
 - 1. Refer to Part 2 Products for applicable sustainable material performance criteria, and Sections 018113 Sustainable Construction Requirements for detailed LEED performance and submittal documentation requirements for each criteria.
 - 2. Provide LEED product data submittal in addition to product data submittal and distribute to the Architect concurrent to the product data submittal.
 - 3. LEED submittals must include completed LEED Product Data Submittal Cover Sheet, included as an attachment to Section 018113, and all supporting documentation required by LEED for criteria indicated in this section.
 - a. Provide cost, volume, and/or surface area data as indicated in the LEED Product Data Submittal Cover Sheet
 - b. Preference is given to regional materials; provide documentation if product has been extracted, manufactured, and purchased within 100 miles of the project site.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with 5 years documented experience.

1.6 MOCK-UP

- A. See Section 014000 - Quality Requirements, for general requirements for mock-up.
- B. Size: 100 sq ft.
- C. Install setting bed, brick pavers, curbs and border, and accessories to pattern indicated.

1.7 FIELD CONDITIONS

- A. Do not install mortar when surrounding air or substrate surface temperature is below 50 degrees F prior to, during, and 48 hours after completion of work.
- B. Do not install mortar when surrounding air or substrate surface temperature is above 90 degrees F during and 48 hours after completion of the work.

- C. Do not install mortar when wind velocity exceeds 15 mph or relative humidity exceeds 50 percent.
- D. At end of working day, or during rainy weather, cover work exposed to weather with waterproof coverings, securely anchored.

PART 2 PRODUCTS

2.1 SUSTAINABLE MATERIALS - LEED

- A. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - 1. Pre-consumer and Post-consumer Recycled Content
 - 2. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - a. Refer to Section 018113 for documentation requirements specific to this criteria.
 - 3. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

2.2 MANUFACTURERS

- A. Brick Pavers:
 - 1. Belden Brick; City Line Extruded Pavers: www.beldenbrick.com/#sle.

2.3 APPLICATIONS

- A. Sidewalks and Residential Driveways: Pavers for pedestrian traffic.
 - 1. Setting Bed: Mortar, with mortar joints.
 - 2. Subbase: Concrete.

2.4 BRICK PAVERS

- A. Pavers for Pedestrian Traffic: Extruded fire clay.
 - 1. Grade: ASTM C902 Weather Class SX Traffic Type I, with dimensional tolerances complying with Application PS.
 - 2. Face Size: 3-5/8 by 7-5/8 inches.
 - 3. Thickness: 2-1/4 inches.
 - 4. Exposed Surface Texture: Sandmold.
 - 5. Edges: Square.
 - 6. Color: Belcrest 760.

2.5 SAND MATERIALS

- A. Polymeric Sand: Fine sand conforming to ASTM C144 combined with polymer binders for creating semi-solid joints between pavers.

2.6 CEMENTITIOUS MATERIALS

2.7 ACCESSORIES

- A. Separation Sheet: No. 15 asphalt roofing felt.
- B. Cleaning Solution: Type recommended by paver manufacturer.
- C. Mortar Bed Joint Filler: Preformed compressible strip complying with ASTM D1751 or ASTM D1752, or closed-cell non-absorbent compressible polyethylene or polymer foam in sheet form; thickness as required to form joint of indicated width; intended to remain in joint to allow moderate movement.
- D. Sealant: ASTM C920, self-leveling or nonsag polyurethane or silyl-terminated polyether/polyurethane (STPE/STPU) sealant approved by manufacturer for traffic exposure without being recessed below the top of substrate surface.
 - 1. Color: As selected by Architect from manufacturer's full color range.
- E. Backer Rod: ASTM C1330, closed-cell polyethylene, 25 to 33 percent larger in diameter than joint width.
- F. Sealer: Penetrating.
 - 1. Product: 511 Impregnator
 - 2. Manufacturer: Miracle Sealants

2.8 MIXES

- A. Cementitious Bed: Portland cement mix conforming to the following:
 - 1. Compressive Strength (28 day): 2000 psi.
 - 2. Slump: 3 to 4 inches.
 - 3. Air Entrained: 5 to 7 percent.
- B. Joint Mortar: ASTM C270, Type M, using the Proportion Specification.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify substrate is ready to support pavers and imposed loads.
- B. Verify gradients and elevations of substrate are correct.

3.2 PREPARATION

- A. See Section 321313 for concrete subbase.

3.3 INSTALLATION - MORTAR SETTING BED

- A. Locate control and expansion joints directly above joints in structural base and where indicated on drawings; use joint filler to form full depth joint before laying mortar bed.
 - 1. Control Joints: 1/4 inch wide.
 - 2. Expansion Joints: 1/4 inch wide.
- B. Place a full cementitious mortar bed of minimum 1 inch thickness over entire paver area.
- C. Place paver units in herringbone pattern from straight reference line.
- D. Place half units or special shaped units at edges and interruptions. Machine saw partial units.
- E. Maintain uniform joint width of 1/8 inch between pavers, and at abutting vertical surfaces and protrusions.
- F. Keep control and expansion joints free of mortar, for sealant installation.
- G. Fill joints with mortar; pack and work into voids; neatly tool surface to concave joint.
- H. Seal control and expansion joints with sealant, in accordance with sealant manufacturer's instructions; use joint filler, backer rod, and or bond breaker tape to achieve width-to-depth ratio recommended by sealant manufacturer.

3.4 INSTALLATION - OVER CONCRETE PAVING

- A. Sweep substrate surface clean of loose matter.
- B. Place separation sheet over paved surfaces in one layer. Butt edges and ends; do not lap.
- C. Place paver units in herringbone pattern to match existing, from straight reference line.
- D. Sprinkle sand over surface and sweep into joints. Moisten joints and recover with additional sand until firm joints are achieved. Remove excess sand.

3.5 CLEANING

- A. Do not clean pavers until pavers and mortar are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.
- E. Broom clean paving surfaces. Dispose of excess sand.

3.6 PROTECTION

- A. Do not permit traffic over unprotected paver surface.
- B. Do not permit traffic for 48 hours after pavement placement.

3.7 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 321416

SECTION 321723 - PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, curb markings, and ISA symbols.

1.2 RELATED REQUIREMENTS

- A. Section 321216 - Asphalt Paving.
- B. Section 321313 - Concrete Paving.

1.3 REFERENCE STANDARDS

- A. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints; 2015 (Reapproved 2020).
- B. California MUTCD - Manual of Uniform Traffic Control Devices for Streets and Highways; State of California Department of Transportation (FHWA's MUTCD as amended for use in California); current edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Certificates: Submit for each batch stating compliance with specified requirements.
 - 1. Painted pavement markings.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.

- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.

1.8 SEQUENCING

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Painted Pavement Markings:
 - 1. Dunn Edwards: Vin-L-Stripe.
 - 2. Pervo Paint Company: Acrylic Traffic Paint.
 - 3. Sherwin Williams: Setfast Acrylic Traffic Paint.
 - 4. Vista Paint Corporation: Traffic Paint.
 - 5. Equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Identify existing markings for removal.
- B. Verification of Conditions: Verify that pavement is dry and ready for installation.
- C. Notify Architect of unsatisfactory conditions before proceeding.

3.2 PREPARATION

- A. Establish survey control points for locating and dimensioning of markings.
- B. Place barricades, warning signs, and flags as necessary to alert approaching traffic.
- C. Clean surfaces prior to installation.
 - 1. Remove dust, dirt, and other debris.
 - 2. Remove rubber deposits, existing paint markings, and other coatings.
- D. Temporary Markings: Apply as directed by Architect.

- E. Apply paint stencils by type and color at necessary intervals.

3.3 REQUIREMENTS

- A. Accessible parking spaces serving a particular building or facility shall be located, and dispersed if serving more than one accessible entrance, on the shortest accessible routes to an entrance or to multiple accessible entrances. CBC Section 11B-208.3.1.
- B. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Section 11B-208.3.1.
- C. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Table 11B-208.2 for each parking facility provided.
- D. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4.
- E. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
 - 1. Parking spaces and access aisles shall be marked according to CBC Section 11B-502.2, 11B-502.3, and 11B-502.3.3. Their surfaces shall comply with CBC Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4.
 - 2. Parking spaces shall be 9' x 18' minimum and van parking spaces shall be 12' x 18' minimum with an adjacent access aisle of 5' x 18' minimum. Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces. Van parking spaces shall be permitted to be 9' x 18' minimum where the access aisle is 8' x 18' minimum.
 - 3. Access aisles shall be marked by a blue painted borderline around their perimeter. The area within the blue borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface, preferably blue or white. Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3.
 - 4. Access aisles (parking spaces as well - similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4.
 - 5. A vertical clearance of 8'-2" minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5.
- F. At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Section 11B-209 and 11B-503 as follows:
 - 1. Vehicle pull-up spaces shall be 8' x 20' minimum. Access aisles shall be 5' x 20' minimum and shall be adjacent and parallel to the vehicular pull-up spaces. They shall be the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-503.4.

2. Access aisles for passenger drop-off and loading zones shall be marked with a painted borderlines around their perimeter. The areas within the borderlines shall be marked with hatched lines a maximum of 36" on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3.
 3. A vertical clearance of 9'-6" minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5.
- G. Bus loading zones and bus stops shall comply with CBC Sections 11B-209 and 11B-810.2 as follows:
1. Boarding and alighting areas shall be 8' x 5' minimum, with 8' measured perpendicular to the curb or vehicle roadway edge, and with 5' measured parallel to the vehicle roadway. Slopes in 8' direction shall be 1:48 maximum. Slopes in 5' direction shall be the same as that of the roadway, to the maximum extent practicable. CBC Figure 11B-810.2.2.
 2. Bus shelters shall provide a minimum 30" x 48" clear floor or ground space (36" x 48" or 36" x 60" as applicable in an alcove), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with CBC Section 11B-305.
 3. Bus shelters shall be connected by an accessible route complying with CBC Section 11B-402 to a boarding and alighting area complying with CBC Section 11B-810.2. CBC Figure 11B-810.3.
- H. Electric Vehicle Charging Stations:
1. Where electric charging stations are provided, they shall be provided in accordance with CBC Section 11B-228.3, Table 11B-228.3.2.1 and CBC Section 11B-812.
 2. Accessibility requirements for Public Use or Common Use EVCS facilities:
 - a. Vehicle spaces and access aisles serving them shall comply with CBC Section 11B-302. Access aisles shall be at the same level as the vehicle space they serve. Changes in level, slopes exceeding 1:48, and detectable warnings shall not be permitted in vehicle spaces and access aisles. CBC Section 11B-812.3.
 - b. Vehicle spaces, access aisles serving them and vehicular routes serving them shall provide a vertical clearance of 8'-2" minimum. CBC 11B-812.4.
 - c. Accessible routes between EVCS parking, equipment and the building or facility served shall be provided per CBC Section 11B-812.5.
 - d. Vehicle spaces for van accessible, standard accessible, ambulatory, and drive-up EVCS shall meet minimum length and width requirements per CBC Section 11B-812.6.
 - e. Accessible EVCS stalls shall be marked "EV Charging Only" per CBC Section 11B-812.9 and Figure 11B-812.9.

- f. Access aisles for van accessible and standard accessible EVCS shall meet minimum length and width requirements and be marked per CBC Section 11B-812.7 the color of the perimeter, hatch lines and “No Parking” letters shall contrast with the surface color (blue color required for use at non-EVCS accessible parking shall not be used). Effective July 1, 2021, where one parking space and one electric vehicle charging space share an access aisle, access aisle marking shall comply with Section 11B-502.3.3 and shall not be required to comply with Section 11B-812.7.2. Additionally, where four or fewer total EVCS are provided within a facility, the access aisle for non-angled van accessible spaces may be located on either the driver or passenger side of the vehicle space. See CBC 11B-812.7.1 exception and 11B-812.7.2 exception.
- g. Where four or fewer total EVCS are provided, identification with an International Symbol or Accessibility (ISA) shall not be required.
- h. Where five to twenty-five total EVCS are provided, one van-accessible EVCS shall be identified with an ISA complying with section CBC Section 11B-703.7.2.1. The required standard accessible EVCS shall not be required to be marked with and ISA.
- i. Where twenty-six or more EVCS are provided, all required van-accessible, and all required standard accessible EVCS shall be identified with an ISA.
- j. The required ISA identification sign shall be reflective with a minimum 70 square inches; shall be visible from the EVCS it serves. The sign shall be permanently posted either immediately adjacent to the vehicle space or within the projected vehicle space at the head end of the vehicle space. Signs identifying van accessible vehicle spaces shall contain the designation “Van Accessible”. Signs shall be minimum 60” above the finish surface except that if the sign projects into a pedestrian circulation area, they shall be minimum 80” above finish surface per CBC Section 11B-812.8.
- k. Ambulatory EVCS complying with CBC Section 11B-812.6.3 shall be required where 26 or more EVCS are provided per CBC table 11B-228.3.2.

3.4 INSTALLATION

A. General:

- 1. Position pavement markings as indicated on drawings.
- 2. Field location adjustments require approval of Architect.

B. Painted Pavement Markings:

- 1. Apply in accordance with manufacturer's instructions.
- 2. Apply in accordance with California MUTCD manual for details not shown.
- 3. Obliterating Paint: Apply as necessary to cover existing markings completely.
- 4. Marking Paint: Apply uniformly, with sharp edges.
 - a. Applications: One coat.
 - b. Wet Film Thickness: 0.015 inch, minimum.
 - c. Stencils: Lay flat against pavement, align with striping, remove after application.
 - d. Length Tolerance: Plus or minus 3 inches.
 - e. Width Tolerance: Plus or minus 1/8 inch.

3.5 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Perform field inspection for deviations from true alignment or material irregularities.
- C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to Owner.
- D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals for additional requirements.
- B. Temporary Markings: Remove without damaging surfaces.

3.7 PROTECTION

- A. Prevent approaching traffic from crossing newly applied pavement markings.
- B. Replace damaged or removed markings at no additional cost to Owner.
- C. Preserve survey control points until pavement marking acceptance.

END OF SECTION 321723

SECTION 323300 - SITE FURNISHINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Benches.
- B. Planters.
- C. Tables.
- D. Waste receptacles.
- E. Bike Rack
- F. Moveable Chairs
- G. Book Drop

1.2 RELATED REQUIREMENTS

- A. Section 047200 - Cast Stone Masonry: Architectural cast stone pots
- B. Section 055000 - Metal Fabrications: Anchors to attach site furnishings to mounting surfaces.
- C. Section 018113 - Sustainable Design Requirements
 - 1. Attachment: LEED Product Data Submittal Cover Sheet

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- E. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.

- G. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2014.
- H. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications and descriptive literature, installation instructions, and maintenance information.
- C. Shop Drawings: Indicate plans for each unit or groups of units, elevations with model number, overall dimensions; construction, and anchorage details.
- D. SUSTAINABLE MATERIALS - LEED
 - 1. Building Product Disclosure and Optimization: Responsible Sourcing criteria
 - a. Pre-consumer and Post-consumer Recycled Content
 - b. For products in this section with defined percentages of pre-consumer and/or post-consumer recycled content by weight, complete applicable sections of the LEED Product Data Submittal Cover Sheet and provide LEED required documentation.
 - 1) Refer to Section 018113 for documentation requirements specific to this criteria.
 - c. Preference is given to products with maximum amount possible of post-consumer recycled content by weight

1.5 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty against defects in materials or workmanship for ductile iron castings for a period of 10 years from Date of Substantial Completion.
- C. Provide manufacturer's Lifetime Warranty against defects in materials or workmanship for wood benches manufactured from solid teak.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Furnishings:
 - 1. Dero; www.dero.com/#sle
 - 2. Landscape Forms; www.landscapeforms.com/#sle
 - 3. Site Pieces; www.sitepieces.com/#sle
 - 4. Substitutions: See Section 016000 - Product Requirements.

B. Precast Furnishings:

1. Quick Crete Products Corp; _____: www.quickcrete.com/#sle.

2.2 METAL FURNISHINGS

A. Metal Furnishings, General:

1. Steel components: Plates, bars, and shapes complying with ASTM A36/A36M and tubing complying with ASTM A500/A500M; cleaned, treated, and powder-coated.
 - a. Color: As selected by Architect from manufacturer's standard range.
2. Recycled plastic lumber (RPL) components:
 - a. Color: As selected by Architect from manufacturer's standard range.
3. Hardware: Stainless steel.

B. Bike rack:

1. Frame: steel
2. Mount: surface
3. Products:
 - a. "Orange" custom rack by Dero

C. Benches: Metal frame and seat section with back.

1. Frame: Steel.
2. Seat: Steel slat.
3. Intermediate arm rest. Locate at midpoint.
4. Mounting: Surface.
5. Products:
 - a. Victor Stanley, Inc; RB-2B: www.victorstanley.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

D. Tables: Steel

1. Configuration: Table and seating.
2. Seating: Compliant with ADA Standards.
3. Mounting: Surface, using concealed anchor rods.
4. Products:
 - a. Site Pieces - Monoline Carousel
 - b. Model: ML-CT-4SEAT-RD

E. Chairs:

1. Products:
 - a. Site Pieces - Monoline Lounge Chair
 - b. Model: ML-LNGECHR-W

F. Waste Receptacles: Aluminum frame with plastic containers and built-in rain shield.

1. Capacity: 36 gallons.
2. Lids:

- a. Material: Aluminum.
3. Mounting: Pedestal embedded in concrete.
4. Products:
 - a. MultipliCITY Double by Landscape Forms; www.landscapeforms.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 PRECAST CONCRETE FURNISHINGS

A. Precast Concrete Furnishings, General:

1. Precast Concrete Components: Mixture of cement, aggregates, water, and mineral colors; molded to shape, and reinforced with steel bars.
 - a. Finish:
 - 1) Horizontal Surfaces: Smooth
 - 2) Vertical Surfaces: Acid etch
 - b. Color: As indicated on drawings.
 - c. Clear Sealers: Anti-graffiti.
2. Hardware: Stainless steel.

B. Planters: Precast concrete with drain holes.

1. Shape: Round.
2. Diameter: 36 inches.
3. Height: 36 inches.
4. Interior Water Sealant: Elastomeric coating.
5. Products:
 - a. 3636 California Round by Quick Crete Products Corp; ____ : qcp-corp.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces, preinstalled anchor bolts, or other mounting devices are properly installed; and ready to receive site furnishing items.
- B. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.
- B. Provide level mounting surfaces for site furnishing items.

END OF SECTION 323300

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 Owner.
- 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. All offsets, fittings, sleeves, etc. which may be required are not shown on the drawings. The Contractor shall 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. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Architect shall have final authority for clarification.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Landscape Architect as soon as detected. In the event this notification is not performed, the 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.

SECTION 323353 - ARCHITECTURAL SITE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete site walls.
- B. Concrete retaining walls.(48" or less in height)
- C. Skateboard deterrents.
- D. Light pole bases.
- E. Other architectural site concrete as indicated.

1.2 RELATED REQUIREMENTS

- A. Division 07 Section - Joint Sealants
- B. Division 09 Section - Permanent Non-Sacrificial Anti-Graffiti
- C. Division 32 Section - Concrete Paving
- D. Division 32 Section - Concrete Paving Joint Sealants

1.3 DEFINITIONS

- A. Cast-in-Place Architectural Site Concrete: Non-building formed concrete that is exposed to view in completed exterior work and that requires concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.
- B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: Fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural site concrete.
- D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

1.4 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place architectural site concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. District's Representative(s).
 - d. Ready-mix concrete manufacturer.
 - e. Architect's Representative(s)
 - f. Cast-in-place architectural site concrete subcontractor.
 - g. Subcontractor for any adjacent work
2. Review testing and inspection procedures, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural site concrete.
3. Contractor to provide meeting minutes for pre-installation conference.

1.5 SUBMITTALS

- A. Product Data: For each type of product.
 1. Proprietary admixtures, pigments, curing compounds, hardeners, sealers, form-release agents, all accessory material, etc.: Indicate compatibility with other materials used.
- B. Samples for Initial Selection: For each type of product, ingredient or admixture requiring color selection.
 1. Submit manufacturer selected range of colors and products for review.
 2. Provide custom colors or samples as required.
 3. Upon selection of color submit 12"X12" sample of material in the specified color/finish for review by the Landscape Architect in addition to the specified mock-ups.
- C. LEED Submittals:
 1. Product Data for Credit MR 4.1 [and Credit MR 4.2]: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
 2. Design Mixtures for Credit ID 1.1: For each concrete mixture containing at least 40% fly ash as a replacement for Portland cement or other Portland cement replacements and for equivalent concrete mixtures that do not contain Portland cement replacements.
- D. Design Mixtures: Submit proposed mix designs and test data for each class, color, application, and strength of concrete and for each method of placement.
 1. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905A.3.

2. Prepare mix designs on the basis of field experience (preferred) and/or trial mixes, in compliance with California Building Code (CBC), Section 1905.3.
 3. Mix designs shall be prepared and signed by a structural or civil engineer registered in the State of California.
 - a. Mix designs shall be reviewed by the Architect and Structural Engineer of Record (SEOR).
 4. Identify for each mix design submitted the method by which proportions have been selected.
 - a. For mix designs based on field experience, include individual strength test results, standard deviation, and required average compressive strength calculations.
 - b. For mix designs based on trial mixtures, include trial mix proportions, test results, graphical analysis and show required average compressive strength face results. Provide gross weight and yield per cubic yard of trial mixes.
 - c. Indicate quantity of each ingredient per cubic yard of concrete.
 - d. Indicate type and quantity of admixtures proposed or required.
 - e. Indicate water to cement ratio by weight.
 - f. Measured slump.
 - g. Measured air content.
 - h. Provide shrinkage test results.
 - i. Provide maximum [5%] fly ash content as Portland cement replacement in all concrete.
 5. Submit proposed alternate design mixtures for review by the Architect and SEOR (Structural Engineer of Record) when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 6. Mix designs for each application must be from a single source for the duration of the project. Multiple vendors or courses will not be permitted.
 7. All mix designs must be wet stamped by a licensed Engineer.
- E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
1. Coordinate with and identify the details of the Contract Drawings on the shop drawings.
 2. Comply with ACI 315, part B and CRSI requirements.
- F. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural site concrete.
1. Engineering Responsibility: Formwork shop drawings shall be prepared by or under the supervision of a licensed professional engineer detailing fabrication, assembly, and support of formwork.
 2. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

3. Location of form ties and patterns are subject to approval of the Landscape Architect. For walls less than 18" high, ties to be located above and below wall face, whenever possible.
 4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.
- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure. Submit dimensioned drawing indicating layout of construction joints, contraction (control) joints, dowelled joints, decorative scoring and placement sequence of concrete.
1. Location of construction joints are subject to approval of the Architect.
 2. Construction joints locations should align with reveal locations as located per drawings.
 3. Provide custom form boards as required for joint alignment noted per drawings.
 4. Align all form joints with reveal locations indicated on plans. Provide custom size and cut form boards as required.
- H. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints including construction joints.
- I. Samples: For each of the following materials:
1. Form-facing panel.
 2. Form ties.
 3. Form liners.
 4. Coarse- and fine-aggregate gradations.
 5. Chamfers and rustications.
 6. Reveals
 7. One quart sample of sand and fine aggregate
 8. On quart sample of coarse aggregate
- J. Qualification Data: For manufacturer (batch plant).
- K. Welding Certificates: Submit certifications signed by AWS Certified Welding Inspector of prequalified welding procedures, qualifications of welding procedures unless prequalified, qualifications of welding operators and qualifications of welders.
- L. Material Certificates: For each of the following:
1. Cementations materials.
 2. Aggregates and sand.
 3. Admixtures.
 4. Form materials and form-release agents.
 5. Steel reinforcement and accessories.
 - a. Provide mill test certificates for all reinforcing steel, showing physical and chemical analyses. For steel that will be welded, include in the chemical analysis the percentages of carbon, manganese, copper, nickel, chromium, phosphorus and sulfur, and optionally, the percentages of molybdenum and vanadium.
 6. Curing compounds.
 7. Surface treatments.

8. Bonding agents.
 9. Adhesives.
 10. Semi rigid joint filler.
 11. Joint-filler strips.
 12. Repair materials.
- M. Material Test Reports: For the following, by a qualified testing agency:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- N. Field Quality-control Reports. Submit reports of all compressive strength, slump, shrinkage and air content tests required by the authorities having jurisdiction and as indicated.
1. Submit copies of delivery tickets complying with ASTM C 94 for each load of concrete delivered to the site. Tickets shall include all information required by the referenced standard.
- O. Minutes of pre-installation conference.

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with CBC Chapter 19A.
1. Chemical products field-applied to concrete shall comply with the air quality requirements of authorities having jurisdiction.
- B. Industry Standards: Comply with the following unless modified by requirements in the Contract Documents.
1. ACI 301, "Specifications for Structural Concrete".
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials".
 3. ACI 302.1R, "Guide for Concrete Floor and Slab Construction".
 4. ACI 303.1 "Specifications for Cast-in-Place Architectural Concrete".
 5. ACI 304R, "Guide for Measuring, Mixing, Transporting, and Placing Concrete".
 6. ACI 305R, "Hot Weather Concreting".
 7. ACI 306.1, "Standard Specification for Cold Weather Concreting".
 8. ACI 318, "Building Code Requirements for Structural Concrete".
 9. ACI 347, "Guide to Formwork for Concrete".
 10. ACI 318, "Building Code Requirements for Structural Concrete."
 11. ACI SP-66, "ACI Detailing Manual".
 12. CRSI, "Manual of Standard Practice".
 13. CRSI, "Placing Reinforcing Bars".
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

2. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 4. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations for Cast-in-Place Architectural Site Concrete: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide cast-in-place architectural site concrete of consistent quality in appearance and physical properties for the duration of the project.
- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specification for Structural Concrete,"[Sections 1 through 5.] [Sections 1 through 5 and Section 6, "Architectural Concrete."]
 2. ACI 303.1, "Specification for Cast-in-Place Architectural Concrete."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Source Limitations for Concrete Paving: Obtain each color, size, type, and variety of concrete material and concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties. Secure all material required for the duration of the project as needed to ensure consistent quality in appearance
- H. Welding Qualifications: Comply with CBC Chapter 17A.
1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
 2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- I. Welding Qualifications: Comply with CBC Chapter 17.
1. Qualify welding procedures and welding personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel" prior to performing any welding.
 2. Qualify welding inspection personnel according to AWS QC1, "Standard for AWS Certification of Welding Inspectors."
- J. Mockups: Before casting architectural site concrete, build mockups to verify selections made under Sample submittals and to fully demonstrate typical joints, surface finish, texture, tolerances, reveals edges, bulkhead or cold joints, standard of workmanship and completed product. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups full-size, matching architectural site concrete components indicated on the Drawings. Mock-ups shall be complete in every detail, including joints, reveals, chamfers, etc. Include complex joinery conditions where necessary to integrate to other Project components as indicated.
3. Maintain accurate records of variables associated with each mockup to facilitate the matching of accepted mockups during actual construction.
4. Demonstrate curing, cleaning, and protecting of cast-in-place architectural site concrete, finishes, and contraction and expansion joints, as applicable.
5. Required Mock-up Types:
 - a. Walls: Construct at least 6 linear feet by 4 foot height of finished concrete site walls for each color, finish, and mix design. Thickness of walls as noted on plans.
 - b. Benches and Seats: Construct at least 6 linear feet of finished concrete site benches and seats.
 - c. Repairs: In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes, honeycombing, spalls, surface blemishes, etc. to match adjacent undamaged surfaces.
6. Mock-up Acceptance: Obtain Architect's approval of mockups before casting architectural site concrete.
 - a. The mock-up acceptance shall be judged between a distance of 5 feet to 10 feet, at the Architects discretion.
 - b. The Architect may reject mockups that, in the Architect's sole judgment, do not demonstrate an acceptable completed product, including, but not limited to, color, joint work, surface finish, texture, tolerances, and standard of workmanship
 - c. The Architect may require modifications to mockups to obtain acceptable results.
 - d. The Architect may require modifications to mockup repairs to obtain acceptable results.
 - e. The Architect may require removal and reconstruction of mockups to obtain acceptable results. Multiple mock ups may be required.
 - f. Contractor shall provide additional mockups as required to obtain results acceptable to the Architect at no additional cost to the Owner.
7. Mockup Disposition: Accepted mockups shall not become part of the completed Project. Maintain mock-up on-site for the duration of construction and until all work has been accepted. Remove and legally dispose mockups after acceptance of final installed work. If sufficient permanent architectural site work has been completed, Contractor may submit a written request to Architect to transfer quality control for architectural site concrete from the accepted mockups to one or more designated portions of the permanent work.

1.7 PROJECT CONDITIONS:

- A. Traffic Control: Maintain access for Owner's operations and for vehicular and pedestrian control required for construction activities.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Label bundles with durable identification tags. Maintain reinforcement identification after bundles are broken.
 - 2. Store reinforcement to avoid excessive rusting or fouling with grease, oil, dirt or other bond-weakening contaminants.
 - 3. Avoid damaging applied coatings, if any, on steel reinforcement.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
- B. Form-Facing Panels for all exposed As-Cast and Exposed-Aggregate Concrete Finishes: Provide steel, glass-fiber-reinforced plastic, or overlain exterior-grade plywood panels, nonabsorptive, that will provide continuous, true, and smooth architectural site concrete surfaces, with no wood grain, honeycombing or patch transfer.
 - 1. Faced plywood panels shall comply with, or be equivalent to, DOC PS 1, Structural I. Provide minimum 7-ply plywood and provide balance sheets for panels coated one-side only. Furnish in largest practicable sizes to minimize number of joints.
 - a. Smooth As-Cast Finish: High-Density Overlay (HDO). Provide one of the following panels, or comparable substituted product:
 - 1) Olympic Panel Products, "Multipour Concrete Form." Overlay Color: Buff.
 - 2) Pacific Laminate Products, "ProFace HDO." Overlay Color: White.
 - 3) Sylvan Products, LLC, "Armor Ply HDO" Overlay Color: Buff.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will provide surfaces without gradual or abrupt irregularities that exceed specified formwork surface class.
 - 1. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
 - 2. Finished work is to be free of seams or form markings.
- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Chamfer Strips: Metal or rigid plastic, 3/4 by 3/4 inch (19 by 19 mm), minimum; nonstaining; in longest practicable lengths.

- F. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800, "Specification 810.1, Expanded Cellular Glazing Tape"; minimum 1/4 inch (6 mm) thick.
- G. Form Joint Sealant: Urethane or silicone elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS that adheres to form joint substrates. Form joint sealant shall be compatible with form-facing panels.
- H. Form Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood. Form sealer shall be compatible with form-facing panels. All seams and joints are to be sealed.
- I. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural site concrete surfaces and will not impair subsequent treatments of those surfaces. Form-release agent shall be compatible with form-facing panels.
 - 1. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
 - 2. Form-release agents shall be non-staining.
 - 3. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- J. Form Ties: Factory-fabricated, stainless steel or fiberglass color keyed to wall color snap ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties with tapered plastic tie cone spreaders that, when removed, will leave holes 3/4 inch in diameter on concrete surface.
 - 2. Furnish internally disconnecting ties that will leave no metal closer than 1-1/2 inches (38 mm) after exposing aggregate, from the architectural site concrete surface.
 - 3. Furnish glass-fiber-reinforced plastic ties, not less than 1/2 inch (13 mm) in diameter, of color selected by Architect from manufacturer's full range.
 - 4. Furnish ties with integral water-barrier plates to walls indicated to receive damp proofing or waterproofing.
- K. Provide new forms specifically purchased for this project. Reuse of forms from past projects or contractors stock will not be accepted.
- L. Provide custom form boards as required to align seams with reveals indicated on plans.

2.2 STEEL REINFORCEMENT AND ACCESSORIES

- A. General: Comply with Division 03 Section "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 60 percent.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed, unless otherwise indicated.

- D. Low-Alloy-Steel Reinforcing Bars (for Welding): ASTM A 706/A 706M, Grade 60, deformed, unless otherwise indicated.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufacture according to CRSI's "Manual of Standard Practice."
 - 1. Where legs of wire bar supports contact forms, use CRSI Class 2, stainless-steel bar supports.
- F. Tie Wire: Minimum 16 ga. annealed wire, black, galvanized or coated finish to match rebar.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II, or Type IV, gray, unless white cement is required to achieve colors indicated. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, complying with building code. Provide aggregates from a single source. All aggregates shall be free of materials with deleterious reactivity to alkali in cement when tested in accordance with ASTM C 289.
 - 1. Comply with CBC section 1903A.3.
 - 2. Comply with CBC section 1903.3.
 - a. Service Class, based on CBC Figure 1904A.2.2, "Weathering Probability Map":
 - b. Severe and Moderate: Class 5S.
 - c. Negligible: Class 2N.
 - 3. Maximum Coarse-Aggregate Size: 1 inch nominal. Maximum size shall also not be larger than 1/4 of the narrowest dimension between forms, 1/3 the depth of slab nor more than 3/4 of the minimum clear spacing between individual reinforcing bars.
 - a. Gradation: Uniformly graded.
 - b. Source: Reliance, San Gabriel, or Carrol Canyon
- C. Normal-Weight Fine Aggregate: ASTM C 33 or ASTM C 144, manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement and free of materials which may cause staining and light in color
 - 1. Source: Reliance, Fosters or Corona.
 - 2. Color to be white to light with no dark material.
- D. Water: Potable, complying with ASTM C 94/C 94M except free of wash water from mixer washout operations.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. 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. Shrinkage-Reducing Admixture: Commercially formulated, shrinkage inhibitor capable of reducing initial shrinkage by 80% and long-term shrinkage by 50%. Provide product suitable for use with either air-entrained or non-air-entrained concrete as appropriate to structural member and project location.
1. Products: Subject to compliance with requirements, provide one of the following(as required):
 - a. Euclid Chemical Company (The), an RPM company; EUCON SRA, SRA+.
 - b. Grace Construction Products, W. R. Grace & Co.; Eclipse Floor, Eclipse Plus.
 - c. Sika Corporation; Control 40.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Clear, Waterborne (Non-Colored Concrete): Provide products complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers, with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
1. Products: Subject to compliance with requirements.
- D. Clear, Waterborne (Colored Concrete): Provide products that are acceptable to concrete color pigment manufacturer complying with ASTM C 309, Type 1, Class B, 18 to 25 percent solids, certified by curing compound manufacturer to not interfere with bonding of sealers with no glossy finish and compatible with specified sealer. Provide products with not more than 100g/L volatile organic content.
1. Products: Subject to compliance with requirements.
- E. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.

2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 SEALERS AND WATER REPELLENTS

- A. Penetrating Liquid Wall and Vertical Surface Treatment (Repellent): Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces. Materials shall be compatible with concrete admixtures and shall be recommended by manufacturer for intended use. Provide products with less than 100g/L volatile organic content.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. L&M Construction Chemicals, Inc.; Hydrolap WB
 - b. ProSoCo Inc.; SL100 Water Repellent
 - c. RainGuard International; Microseal(For use with VandalGuardTEN Anti-graffiti coating)

2.7 ANTI-GRAFFITI COATING

- A. Refer to Section 099620 Permanent Non-Sacrificial Anti-Graffiti Coating for product and specific sealer.
 1. Compatible sealer to be applied prior to use of Anti-graffiti coating.

2.8 JOINT DEVICES, FILLER MATERIALS AND OTHER ACCESSORY PRODUCTS

- A. Joint Filler at Exterior Sealed Joints: ASTM D 1751
 1. 1/4" asphalt-saturated cellulosic fiber.
 2. Lightweight, nonstaining, polyethylene closed cell expansion joint filler
 - a. Deck-O-Foam as manufactured by W.R.Meadows, Hampshire, Ill.
 3. Exterior Expansion- and Isolation-Joint-Filler Strips: See Division 32 Section "Concrete Paving Joint Sealants" for sealants for exterior joints at concrete pavements.

2.9 REPAIR MATERIALS

- A. General: Provide cementitious materials, coarse aggregates, fine aggregates, water, bonding agents and admixtures as required to prepare repair grouts that will match as-cast and site finished architectural site concrete.
 1. Maintain accurate records of repair materials and mixtures used on accepted mockups.
- B. Bonding Agent: ASTM C 1059, Type II, non-re-emulsifiable. Provide proprietary products composed of latex polymers.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. W.R. Meadows, Inc.; Acry-Lok.
 - b. Grace Construction Products, W. R. Grace & Co.; "Daraweld C".
 - c. Larsen Products Corp., "Weld-Crete".

2. Epoxy Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete and for anchoring dowels to hardened concrete.

2.10 SKATEBOARD DETERRENTS

- A. General: Provide the following skateboard deterrents, unless otherwise indicated.
 1. Basis of Design Product: Subject to compliance with the requirements, provide the following, or comparable substituted product:
 - a. Intelliccept, Inc., "Skatestoppers Diamond Insert series," aluminum alloy, mill finish, model as required to match formed edge.
 - 1) Model DR05-8, to match 1/2" radiused edge

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of cast-in-place architectural site concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.
 2. Proportioning:
 - a. The proportioning of ingredients shall be such that the concrete can be readily worked into forms and around reinforcement under the conditions of placement to be used, without segregation or excessive bleeding.
 - b. When proportioning by weight of loose, dry material, 94 pounds of cement shall be considered 1 cubic foot.
 - c. Fine aggregate volume shall be at least 35 percent, with a maximum of 50 percent, of the sum of the separate fine and coarse aggregate volumes.
 - d. Total water content shall not exceed 35 gallons per cubic yard of concrete.
 - e. Weighing equipment shall be accurate within 1 pound and shall be adjustable for varying aggregate moisture content.
 - f. A beam auxiliary shall register any part of the last 100 pounds of each aggregate. The aggregate hopper shall have a volume adjustment.
 3. Prepare compressive strength data for both 7-day and 28-day strengths.
 - a. The 7-day compressive strength shall be at least 60 percent of the required 28-day strength.
 - b. The 28-day compressive strength shall be as indicated.
 4. Provide drying shrinkage test data at 28 days, from not less than 3 test specimens.

- B. Cementitious Materials-General: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not more than 5 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:
 - 1. Cementitious Materials-LEED Supplemental: For LEED-NC Credit ID 1.1: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 40 percent. Per ACI 301 limits for concrete exposed to de-icing chemicals, limit percentage, by weight, of cementitious materials other than Portland cement in concrete as indicated above.
 - 2. Fly Ash: 0-5 percent.
- C. Proportion concrete mixtures as follows:
 - 1. Minimum Compressive Strength (28 Days): 3000 psi.
 - a. Provide the following minimum compressive strength (28 days) where required by high-pressure water or bush hammer finishing techniques: 4500 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50-0.60.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch, unless indicated otherwise.
 - 4. Slump Limit (High-Range Water-reducing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture, plus or minus 1 inch, unless indicated otherwise.
 - 5. Slump Limit (Plasticizing Admixture): 8 inches for concrete with verified slump of 2 to 4 inches before adding plasticizing admixture, plus or minus 1 inch, if required/unless indicated otherwise.
- D. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb./cu. yd. (0.60 kg/cu. m), unless indicated otherwise.
- E. Air Content, Exterior Exposed Concrete: Provide the following air entrainment for all exposed concrete with a weathering probability of severe or moderate per CBC figure 1904.2.2/1904A.2.2.
 - 1. Provide air entrainment of 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size, unless indicated otherwise.
- F. Slump Limit: [4 inches (100 mm)] [8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture], plus or minus 1 inch (25 mm), unless otherwise indicated.
- G. Cementitious Materials: For cast-in-place architectural site concrete exposed to deicers, limit percentage, by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.[Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.]

1. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] percent by weight of cement.
- H. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement. Limit total chloride-ion content in hardened concrete to 0.10 percent by weight of concrete when tested per AASHTO T 260 potentiometric titration.
 2. Limit "drying shrinkage" after 28 days of curing hardened concrete to 0.045 percent of the original concrete volume.
 3. Admixtures: Admixtures may only be used if they are incorporated into the accepted concrete mix designs. Use admixtures according to manufacturer's written instructions.
 - a. Use [water-reducing] [high-range water-reducing] [or] [plasticizing] admixture in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - c. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - d. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- I. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with accepted mockup.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
 1. Splices: Do not splice bars, unless indicated on the Drawings.
 2. Staggered Splices: Stagger splices such that not more than one-half of the reinforcing bars are spliced at any location.

2.13 CONCRETE MIXING

- A. Ready-Mixed Architectural Site Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M [and ASTM C 1116/1116M] and furnish batch ticket information.
 1. Clean equipment used to mix and deliver cast-in-place architectural site concrete to prevent contamination from other concrete.
 2. When air temperature is between 85 and 90 deg. F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F, reduce mixing and delivery time to 60 minutes.
 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.

- B. Integral Colored Concrete Mixes: Add pigments at the concrete batch plant. Minimum batch size shall be three (3) yards. The same brand of cement, source of sand, and water/cement ratio shall be maintained for each load of the same color for the duration of the project.
 - 1. Batching Procedure: Before adding color-conditioning admixture, the mixing drum shall be thoroughly cleaned and wetted with approximately 40 gallons of the mix water and/or a portion of the aggregates. After cleaning and wetting of the drum, add the specified quantity of admixture correctly packaged for the mix design and batch quantity. Proceed with normal batching of balance of ingredients. After loading is complete, mix at mixing speed for a minimum of 15 minutes. Do not add water after a portion of the load has been discharged.

2.14 BRICK CLADDING

- A. As indicated on the drawings.
- B. See Section 04 74 14 'Adhered Manufactured Stone Veneer' for substrgeneral, materials, and execution requirements.

PART 3 - EXECUTION

3.1 FORMWORK

- A. General: Comply with the following, unless otherwise indicated:
 - 1. Conform to ACI 318, ACI 347 and CBC Section 1906.
 - 2. Conform to ACI 318, ACI 347 and CBC Section 1906A.
- B. Structural Loads: Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- C. Geometry: Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Provide for necessary openings, inserts, anchorages, and other features indicated or required. Properly locate all elements.
 - 1. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - a. Class A, 1/16 or 1/8 inch for smooth-formed finished surfaces.
 - b. Class B, 1/4 inch (6 mm) for rough-formed finished surfaces.
- D. Form Joints: Minimize form joints and make forms watertight to prevent leakage of concrete mortar. Locate form joints at exposed concrete symmetrically about center of panel and aligned with reveals, unless otherwise indicated. Align joints symmetrically at exposed conditions.
 - 1. Seal penetrations at form ties with form joint sealant to prevent cement paste leakage.
 - 2. Provide custom form boards as required to align with reveals.

- E. Removal: Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where dismantling or 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. Chamfers: Chamfered edges are not allowed.
- G. Chamfers: Provide chamfered edges and corners at all exposed locations, and at all locations scheduled to receive waterproofing, unless otherwise indicated.

3.2 EARTH FORMS

- A. General: Unless indicated, placement of concrete directly against soil or earth (casting "neat") shall not be permitted only with the prior approval of the Structural Engineer of Record. Concrete placed directly against earth shall require a minimum increase in concrete thickness of 1" at vertical faces. For example, footings shall be 2" wider than indicated if both vertical faces are cast against earth.
- B. Trimming and Cleaning: Hand trim sides and bottoms of soil forms and trenches. Remove loose soil, exposing undisturbed native soil, and prior to placing concrete.

3.3 CONSTRUCTED FORMWORK

- A. 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.
- B. 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.
- C. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- D. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- E. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- F. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

- G. Provide bracing and shores to ensure stability of formwork and accommodate all loads. Use form ties of sufficient strength and in sufficient quantities to prevent formwork spreading. Maintain principal shores to support concrete until required strength is achieved.

3.4 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 embedded accessories level, true-to-line and plumb in accordance with manufacturer's instructions.
 - 2. 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."
 - 3. Provide reveals around embedded items such as light fixtures as shown on Drawings.

3.5 OPENINGS, DEPRESSIONS, RECESSES AND CHASES

- A. Size and locate formed openings, depressions, recesses and chases to accommodate products to be applied to, built-into and/or pass-through concrete Work. Coordinate size, location and placement of inserts, embedded products, openings and recesses with Work of other sections. 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.

3.6 FORM RELEASE AGENTS

- A. General: Provide either form materials with factory-applied non-absorptive liner or field-applied form coating. Field-applied coating shall be non-staining.
 - 1. Non-absorptive Liner: Rust on steel form surfaces is not acceptable.
 - 2. Field Applied Coating: Comply with manufacturer's written instructions. Obtain written acceptance of form release agent from integral colored concrete pigment manufacturer.
 - a. Reapply coating to thoroughly cleaned and reconditioned formwork before each use.
 - b. Verify compatibility of release agents with integrally-colored concrete and all subsequently applied curing compounds, coatings, applied finishes, etc. Do not apply release agent if items are non-compatible.
 - c. Do not apply release agent where decorative wood graining is intended for concrete surface. Leave form face dry.

3.7 CONCRETE SURFACE RETARDERS

- A. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

3.8 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of walls, steps, 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 72 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. Schedule form removal to maintain surface appearance that matches accepted mockups.
 - 2. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength, but not less than 21 days after pour.
 - 3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
 - 4. All formwork is to be new specifically purchased for this project.
- B. Clean and repair surfaces of forms to be reused in the Work in non-exposed areas. 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.

3.9 STEEL REINFORCEMENT

- A. General: Place and secure reinforcement as indicated. Comply with CRSI publications "Manual of Standard Practice" and "Placing Reinforcing Bars".
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
 - 2. Do not bend bars more than once.
 - 3. Do not bend or straighten reinforcement in a manner injurious to the material, such as heating.
 - 4. Do not use bars with kinks or bends not indicated.
 - 5. Do not use bars with reduced cross-section due to corrosion or other cause.
 - 6. Remove and replace all defective bars.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Space reinforcement as indicated. If not indicated, maintain clear spacing of not less than the bar diameter, 1-inch, or 1-1/3 times the maximum aggregate size, whichever is greater. Where parallel reinforcing is placed in more than one horizontal layer, place as many bars as possible in the outboard layer, maintaining the required lateral clearances and spacing's. Place bars in the inboard layer in direct vertical alignment with the bars of the outboard layer. Maintain not less than 1-inch or the maximum bar diameter in the inboard/outboard layers, whichever is greater, clear space between vertically stacked bars.
- D. Accurately position, support, and secure reinforcement against displacement.

1. Maintain reinforcing steel positions during placement operations. Properly reset any reinforcement that is displaced by runways, workmen and other causes.
- E. Locate and support reinforcement with bar supports to maintain minimum concrete cover as indicated or as required by ACI 318.
- F. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- G. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- H. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.10 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction or Cold Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Locate horizontal joints in walls and columns as indicated.
 3. Space vertical joints in walls as indicated and as may be directed by the Architect. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 6. Align joints with reveals indicated. Provide custom cut form boards as required.
 7. Do not place expansion material at cold joints.
- C. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, walls 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 Division 07 Section "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.

3.11 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, form-release agent, surface retarders, reinforcement, and embedded items is complete and that required inspections have been performed.
 1. Provide protective coatings, coverings and masking's to protect adjacent Work.
 2. Provide temporary runways and other appropriate equipment as necessary to access Work area and to avoid soiling or damage to existing Work.
 3. Prevent run-off of concrete hydration water and water polluted by agents and chemicals from soiling existing surfaces or contaminating landscape areas.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
 2. If indicated in mix design accepted by the Architect, water added to concrete shall be observed by the Project Inspector, and shall be recorded on the delivery ticket.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- 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. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. No visible cold joints or lift lines are acceptable in the completed work.
 3. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
 4. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms. 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.
 5. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 6. Maintain reinforcement in position on chairs during concrete placement.
 7. Screed slab surfaces with a straightedge and strike off to correct elevations.
 8. Slope surfaces uniformly to drains where required.

9. Begin initial floating using bull floats or derbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
 4. Do not use chemical accelerators unless otherwise specified and accepted in design mixtures.
- F. Hot-Weather Placement: Comply with ACI 305R 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.

3.12 FINISHES, GENERAL

- A. Architectural Site Concrete Finishes: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.
- B. Architectural Site Concrete Finishes: Match accepted mockups to satisfaction of Architect.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.
1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- D. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.13 AS-CAST FORMED FINISHES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects to match the accepted mockups. 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 exceeding specified limits on formed-surface irregularities.
- B. Smooth-Formed Finish is the general finish required for all formed integral-colored concrete, unless otherwise indicated. Rubbed finishes are unacceptable.
- C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
- D. Smooth-Rubbed or Sponged 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.
- E. 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 surrounding concrete. 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.
- F. 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 surrounding concrete. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- G. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.14 EXPOSED-AGGREGATE FINISHES

- A. Scrubbed Finish: After concrete has achieved a compressive strength of from 1000 to 1500 psi (6.9 to 10.3 MPa), apply scrubbed finish. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed. Rinse scrubbed surfaces with clean water. Maintain continuity of finish on each surface or area of Work. Remove only enough concrete mortar from surfaces to match design reference sample or mockup.
- B. High-Pressure Water-Jet Finish: Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of 4500 psi (31 MPa). Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.

1. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in reveal projection to match design reference sample or mockup.
- C. Retarder Finish: Remove formwork without damaging edges or reveals.
 1. Ensure finish is even and no honeycombing or discoloration is apparent
 2. Edges shall not be chipped or spalled
- D. Abrasive Blast Finish: Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi and is at least 28 days old. Coordinate with formwork removal to ensure that the surfaces to be abrasive blasted are treated at same age for uniform results.
 1. Surface Continuity: Perform abrasive-blast finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances in depths of blast to match design reference sample or mockup.
 2. Abrasive Blasting: Abrasive blast corners and edges of patterns carefully, using backup boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure, and blasting techniques required to match design reference sample or mockup.
 3. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match design reference sample or mockup, as follows:
 - a. Brush: Remove cement matrix to dull surface sheen and expose face of fine aggregate; with no significant reveal.
 - b. Light: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; with maximum reveal of 1/16 inch (1.5 mm).
 - c. Medium: Generally expose coarse aggregate; with slight reveal, a maximum of 1/8 inch (3 mm).
 - d. Heavy: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter; with reveal range of 1/4 to 5/16 inch (6 to 8 mm).
- E. Bush hammer Finish: Perform bush hammer finish on concrete that has achieved a minimum compressive strength of 4500 psi (31 MPa), and has been allowed to cure at least 21 days before starting bush hammer surface finish operations.
 1. Surface Continuity: Perform bush hammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match design reference sample or mockup.
 2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
 3. Remove impressions of formwork and form facings with exception of tie holes.

3.15 SKATEBOARD DETERRENTS

- A. General: Install skateboard deterrents in epoxy adhesive supplied by manufacturer, in accordance with manufacturer's instructions.
 - 1. Install as shown. If not shown, install in symmetrical fashion on all formed edges within 4 feet (1.22 m) of adjacent grade, at intervals not to exceed 3 feet (1.1 m) O.C.

3.16 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 305R for hot-weather protection during curing.
- B. Begin curing cast-in-place architectural site concrete immediately after removing forms from concrete or after applying as-cast formed finishes to concrete, consistent with mockup preparation. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:
 - 1. Moisture Curing: Keep exposed surfaces of cast-in-place architectural site concrete continuously moist for no fewer than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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 no fewer than seven days. Immediately repair any holes or tears during curing period; use cover material and waterproof tape.
 - 3. Curing Compound: Mist concrete surfaces with water. Apply curing compound 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.

3.17 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 in accordance with the CBC and ACI 301.
 - 1. Comply with the requirements of Division 01 Section "Quality Control".
 - 2. Comply with the requirements of Division 01 Section "Quality Control-DSA".
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Structural 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.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg. F and below and when 90 deg. F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and reserve one set of two specimens for testing at 56 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 7. 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, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M 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.

3.18 DEFECTIVE CONCRETE

- A. The following list includes, but is not limited to; concrete that will be deemed to be defective and non-conforming. All such concrete shall be removed and replaced with Work complying with the requirements of the Contract:
 1. Concrete not formed as indicated, not true to alignment indicated, not plumb where intended, not level where intended, not true to level or elevation intended.
 2. Concrete voided or honeycombed, including voids and honeycombs that have been cut, resurfaced or filled without prior approval of the Architect.
 3. Concrete with exposed reinforcement.
 4. Concrete with inadequate cover over reinforcement.
 5. Concrete with embedded foreign objects and debris, including sawdust, wood or metal shavings, nails, cans, trash, etc.
 6. Concrete that does not visually match the accepted mockups [or the designated design reference sample].
 7. Other non-conforming work.
- B. All concrete deemed to be defective by the Architect or in non-conformance with the contract documents is to be removed and replaced from expansion joint or cold joint to expansion joint or cold joint at no cost to the owner. Repair defective concrete as directed by the Architect, at no cost to the Owner.

3.19 SEALERS AND REPELLENTS

- A. General: Uniformly apply a continuous sealing coat of sealers or repellents to all exposed surfaces of architectural site concrete by power spray or roller according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 28 days old.
- B. Penetrating Liquid Floor and Horizontal Surface Treatment (Sealer): Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- C. Penetrating Liquid Wall and Vertical Surface Treatment (Sealer/Repellent): Prepare, apply, and finish penetrating liquid repellent treatment according to manufacturer's written instructions.

3.20 ANTI-GRAFFITI COATING

- A. Refer to Section 099620 Permanente Non-Sacrificial Anti-Graffiti Coating.
- B. Apply to all exposed architectural site concrete.
- C. Apply compatible sealer to exposed architectural site concrete prior to installation of Anti-Graffiti coating.

3.21 REPAIRS, PROTECTION, AND CLEANING

- A. Patching or sacking of damaged or defective concrete as determined by the Architect is not permitted. Remove and replace all damaged or defective concrete from joint to joint. Remove/Repair and cure damaged or defective finished surfaces of cast-in-place architectural site concrete when accepted by Architect. Match repairs to color, texture, and for any replaced work/uniformity of surrounding surfaces and to repairs on approved mockups.
- B. Remove and replace cast-in-place architectural site concrete that does not match mockups accepted by Architect.
- C. Protect corners, edges, and surfaces of cast-in-place architectural site concrete from damage; use guards and barricades.
- D. Protect cast-in-place architectural site concrete from staining, laitance, and contamination during remainder of construction period.
- E. Clean cast-in-place architectural site concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

- F. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.
 - 1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural site concrete finishes.

END OF SECTION 323353

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- 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

- A. 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 or Owner's standards will be rejected and shall be removed from the site at no expense to the Owner.

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.

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. Isolation 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. Automatic Control Valves:

1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Automatic control valves shall be electrically operated.
3. Provide Christy's valve ID tags for each remote control valve with valve number.
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 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 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. Drip automatic control valve boxes shall be "Jumbo" sized rectangular shape. Valve box covers shall be marked "DCV" with the valve identification number "heat branded" onto the cover in 1 inch-high letters/numbers.
- G. Quick coupler, ball valve boxes, and grounding stake boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "BV" or "GRD" "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

- A. Drip tubing equipment such as flush valves, air relief valves, wye strainers and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

2.10 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:
1. 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:
1. 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.

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 on 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, drip emitters, and inline drip tubing shall be installed as indicated on the drawings.
- B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.
- C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

3.11 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.
- D. Coordinate with synthetic turf sub contractor to install synthetic turf at turf cup kits per manufacturer recommendation.

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

- A. 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

- A. 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 328400

SECTION 329119 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Weeding.
- B. Finish grading for lawns
- C. Finish grading for planting areas.

1.2 RELATED REQUIREMENTS

- A. Division 31 Section Site Clearing
- B. Division 31 Section Earthwork
- C. Division 32 Section Decomposed Granite Surfacing
- D. Division 32 Section: Landscape Work

1.3 DEFINITIONS

- A. Finish Grading: finish grading shall consist of adjusting and finishing soil surfaces with site or imported topsoil, raking grades to a smooth, even, uniform plane. Remove and legally dispose of all extraneous matter off site. Facilitate natural run-off water and establish grades and drainage indicated as part of the contract work.
- B. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- C. Finish Grading: Finish grading shall consist of finishing surfaces by raking smoothly and evenly to facilitate natural run-off water, and by removing and disposing of extraneous matter.
- D. Sub-grade: The surfaces upon which additional specified materials are to be placed, prepared, or constructed.
- E. Rough Grade: The establishment of grades to required tolerances.
- F. Finish Grade: Spot elevations (grades) are indicated based on the best available data. Contract Civil Drawings are referenced to provide additional site grading information. It is intended that constant slopes are maintained between spot elevations.

- G. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 EXISTING UTILITIES

- A. Stake and mark the location of existing utilities before commencing work.
- B. Retain and protect in operating condition all active utilities traversing the site designated to remain.

1.6 QUALITY ASSURANCE

- A. Finish grade shall conform to contours, grades, lines, and shapes, as indicated on Contract Drawings, with uniform slopes between finish grades or between finish grades and existing grades.
- B. Establish finish landscape grades in a continuous, uniform line, resulting in a uniform surface with no ridges or water pockets.
- C. Finish landscape grade tolerance shall be 0.04-feet plus-or-minus from finish elevations indicated on site drawings.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS:

- A. Topsoil: A natural, fertile, friable soil, free from stones, roots, clods larger than 1" in diameter, noxious seeds, weeds, subsoil, undesirable insects, plant disease or any other natural objects detrimental to normal plant growth.
 - 1. Silt plus clay content of the import soil shall not exceed 20% by weight with a minimum 95% passing 2.0-millimeter sieve.
 - 2. Total pore space content on a volume/volume basis shall be at least 15 percent at field capacity.
 - 3. Permeability rate shall be not less than one inch per hour or more than 20 inches per hour.
 - 4. The sodium absorption ratio (SAR) shall not exceed 6 and the electrical conductivity (ECE) shall not exceed 2.0 milliohms per centimeter at 25 degrees centigrade.
 - 5. Soluble boron shall be no greater than 1.0 part per million (mg/l).
 - 6. Soil pH range shall be 6.0 - 7.9.
 - 7. Maximum concentration of soluble chloride shall be 150 parts per million.

8. Maximum concentration of heavy metals shall not exceed the following when the pH is between 6 and 7:
 - a. Arsenic: 1 ppm
 - b. Cadmium: 1 ppm
 - c. Chromium: 5 ppm
 - d. Cobalt: 1 ppm
 - e. Lead: 15 ppm
 - f. Mercury: 0.5 ppm
 - g. Nickel: 2.5 ppm
 - h. Selenium: 1.5 ppm
 - i. Silver: 0.25 ppm
 - j. Vanadium: 1.5 ppm
 9. Petroleum hydrocarbons shall not exceed 100 mg/kg dry soil.
 10. Aromatic volatile organic hydrocarbons shall not exceed 2 mg/kg dry soil.
- B. Obtain imported topsoil from approved local sources.
- C. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of Section 329300.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Verification of conditions: Prior to commencing the finish grading, review the installed work of other trades and verify that their work is complete.
 1. Rough Grading: Grading in planting areas (except raised planter areas) shall be established to within plus or minus 0.10 foot prior to beginning of finish grading.
- B. Import topsoil only when necessary to supplement site soil to achieve grades shown on Drawings, or if site soil is unsuitable for planting.

3.2 PREPARATION:

- A. Weeding: Before finish grading, weeds and grasses shall be dug out by the root or sprayed with an herbicide and disposed of off-site. This procedure is outlined in Section 329300-Landscape Work.
- B. Remove debris, roots, branches, weeds, stones, in excess of 1/2-inch (13 mm) in size and clumps of earth that do not break up. Before and during finish grading, remove weeds and grasses, including roots, and dispose off-site.
- C. Remove soil contaminated with petroleum products and legally dispose off-site.

3.3 INSTALLATION:

- A. General: When rough grading and weeding have been completed, and the soil has dried sufficiently to be readily worked, lawn and planting areas shall be graded to the elevations indicated on the Drawings.
 - 1. Grades indicated on Drawing are grades that will result after thorough settlement and compaction of the soil.
 - 2. Grades not otherwise indicated shall be uniform finish grades and, if required, shall be made at the direction of the Architect.
 - 3. Finish grades shall be smooth, even, and a uniform plane with no abrupt change of surfaces.
 - 4. Soil areas adjacent to buildings shall slope away from the building to allow a natural run-off of water, and surface drainage shall be directed as indicated on the drawings by remodeling surfaces to facilitate the runoff water at 2% minimum grade.
 - 5. Low spots and pockets shall be graded to drain properly.
- B. Drainage: Finish grade with proper slope to drains.
 - 1. Flow lines, designated or not, shall be graded and maintained to allow free flow of surface water.
 - 2. If any drainage problems arise during construction period due to Contractor's work (such as, but not limited to, low spots, slides, gullies and general erosion), the Contractor shall be responsible for repairing these areas to a condition equal to their original condition, and in so doing shall prevent further drainage problems from occurring.
- C. Prior to placing backfill, remove rock, aggregate base, concrete, and deleterious materials to a depth of 18 inches below soil grade in planter areas. Cross-rip subsoil of friable soil to a depth of 12-inches.
 - 1. Place a minimum of [15-inches] of topsoil backfill in planters.
 - 2. Refer to Section 329300 "Landscape Work" for soil materials.
- D. Toe of slope: To prevent soil creep or erosion across pavement, where pavement (walk, curb, etc.) is at the toe of a slope, finish grade is to level out or swale slightly at least 12-inches before reaching pavement.
- E. Moisture Content: The soil shall not be worked when the moisture content is so great that excessive compaction occurs, nor when it is so dry that dust may form in the air or that clods do not break readily. Water may be applied, if necessary, to provide moisture content for tilling and planting operations. It is the Contractor's responsibility to control dust that is spread as a result of grading operations.
- F. Grades: The finish grade in areas to be planted with turf shall be 1-inch below grade of adjacent pavement, walks, curbs, or headers. Finish grade in shrub areas shall be 1 1/2-inches below adjacent surfaces. Exceptions may be made when drainage conditions require flush grades, as directed by the Architect.

- G. Compaction: Soils in planted areas shall be loose and friable, yet firm enough that no settling occurs from normal foot traffic or irrigation.

3.4 FIELD OBSERVATION:

- A. It is the Contractor's responsibility to contact the Architect 48 hours or two working days in advance of each agreed observation or conference.
- B. Schedule for On-Site Reviews: at completion of finish grading and prior to any planting operations.
 - 1. See "Site Observation" in Part 3 of Section 329300-Landscape Work to coordinate inspections and review of work.

END OF SECTION 329119

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SECTION 329300 - LANDSCAPE WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Soil Prep and Fertilization.
- B. Planting Operation.
- C. Planting Materials.
- D. Topsoil and Planter Mix.
- E. Agronomic Testing.
- F. Drainage Materials.
- G. Jute Mesh and Erosion Control.
- H. Mulching.
- I. Hydroseeding
- J. Pruning
- K. Tree stabilization.
- L. Edgings.
- M. Root Barriers.

1.2 RELATED REQUIREMENTS

- A. Division 01 Temporary Tree and Plant Protection
- B. Division 12 Section Site Furnishings.
- C. Division 31 Section Site Clearing
- D. Division 32 Section Landscape Grading
- E. Division 32 Section Landscape Irrigation
- F. Division 32 Section Landscape Maintenance
- G. Division 33 Section Storm Drainage Utilities

1.3 REFERENCE STANDARDS

- A. American Association of Nurserymen, Inc. (AAN)
 - 1. American Standard for Nursery Stock, latest edition (ANSI).

1.4 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- D. Bare-Root Stock: Exterior plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
- E. Clump: Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
- F. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
- G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
- H. Finish Grade: Elevation of finished surface of planting soil.
- I. Sub-grade Elevations: Excavation, filling and grading required to establish elevations is shown on drawings. Coordinate all work with grading contractor in order to arrive at rough grades that will allow tolerance for topsoil in planting areas, soil amendments and ornamental mulch as required in other sections of this specification. Contractor to assume tolerance of rough grades established at ± 0.09 feet (less than 1 tenths of a foot)

- J. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- K. "Diameter at breast height" (DBH) is measurement for tree trunk caliper.
- L. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- M. Planting Soil: Native or imported topsoil; mixed with soil amendments.
- N. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- O. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- P. Pruning: As designated on contract drawings. Items not specifically indicated or specified, but normally required to conform with such work, are considered part of the work.

1.5 SUBMITTALS

- A. WITHIN 30 DAYS OF START OF THE ROUGH GRADING OPERATIONS:
 - 1. Submit a certificate indicating all plant material has been secured for the project and is available.
 - 2. Submit documentation that all plant material has been ordered in accordance with Article 1.06 of this section.
- B. CERTIFICATION: Submit the following:
 - 1. Certificates of inspection as required by governmental authorities when transporting materials into the state.
 - 2. Bulk Materials: Submit a certificate of delivery for all material in containers or bulk.
- C. TEST REPORTS: Submit the following:
 - 1. Agronomic Soils Laboratory Test Report(s) including required amendments and maintenance recommendations.
- D. PRODUCT DATA: Submit the following:
 - 1. In accordance with Division 1 Section "Submittal Procedures", submit complete manufacturer descriptive literature and specifications for proprietary materials and any additional items required by the Architect. Prior to start of construction and submittals; furnish to the Architect the list of items to be submitted and reviewed.
 - a. Soil Amendments (as identified in Agronomic Soils Report).
 - b. Fertilizer (as identified in Agronomic Soils Report).
 - c. Plant Tablets.
 - d. Stakes and Guys.

- e. Tree Ties and Vine Ties.
- f. Seed Mixtures.
- g. Hydroseed Materials.
- h. Mulch.
- i. Hydroseeding: Furnish certificate, in writing, stating that the hydroseeding has been installed as specified.
- j. Edging Material.
- k. Filter Fabric.
- l. Drainage Materials.
- m. Accessory Material.(Root barriers, Tree Grates, Metal edging, Boulders, etc.)
- n. Other soil additives per Agronomic Soils Report.
- o. Submit other data substantiating that materials comply with specified requirements. Such certificates may be tags, labels, and/or manufacturers literature. All submittals shall be reviewed and accepted by the Architect before contractor begins work.
- p. Substitution Request
 - 1) If any plant specified is not obtainable, submit a written substitution request to the Architect during the bidding period.
 - 2) Substitutions of plant material will not be permitted unless accepted in advance in accordance with the provisions of Division 1 Section "Product Requirements."
 - 3) The Contractor is responsible for contract growing all required plant material for to project to ensure availability in the size and requirements of the project.
 - 4) All substitution requests for any material must be made during the bid process.
No substitution requests will be permitted after the bid process or during.
- q. With submittal of Bid Documents, submit complete list of plant materials to be provided, including unit prices for plants and for installation. Include:
 - 1) Quantity.
 - 2) Size.
 - 3) Botanical Name.
 - 4) Plant Unit Price.
 - 5) Installation Unit Price.
- 2. PLANTING SCHEDULE: Submit proposed planting schedule at least two months prior to planting any materials, indicating dates for each type of landscape work coinciding with normal seasons for such work. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. If dates need to be revised after acceptance of planting schedule, document reasons for delays and submit for acceptance.

3. Submit two photos of each tree(include DBH, height and spread), shrub(include height and width) and groundcover(include height and width) with a person in the image to be used on the project to the architect for review. Photos are to be of the actual material tagged, or secured and that will used for the project at the sourced nursery. No plants may be delivered or planted prior to approval by Architect.

1.6 QUALITY ASSURANCE

A. QUALIFICATIONS

1. Nursery Qualifications: Regularly engaged, for the preceding ten years, in the production of planting materials equivalent in species and size to those required.
 - a. Stocked, and having a demonstrated ability to provide plant materials required within the constraints of the accepted construction schedule.
 - b. Landscaper's Qualifications: Regularly engaged and specializing, for the preceding ten years, in the installation and maintenance of planting materials equivalent in species and size to those required.
 - 1) Capable of furnishing a verifiable list of not less than five projects of equivalent type successfully completed within the preceding two years.
 - 2) Subcontracts: Landscape work to a single firm specializing in landscape installation.
2. Pre-Installation Conference: Schedule in advance of beginning work of this section. Arrange for attendance by Owner, Architect, and landscaping subcontractor. Review intent of Contract Documents and resolve conflicts. Prepare minutes of conference and distribute to attendees within five (5) days.
3. Source Quality Control
 - a. General: Comply with regulations applicable to shipping of landscape materials.
 - b. Analysis and Standards: All materials shall be of standard, approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacture's guaranteed analysis. The Contractor shall supply the Architect with a sample of all materials accompanied by analytical data from an approved laboratory source illustrating compliance of bearing the manufactures guaranteed analysis.
4. Soil-Testing Laboratory Qualifications: An independent 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.
5. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.

- a. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
6. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 3/4-inches (19 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
 - a. Obtain topsoil only from naturally, well drained sites where topsoil occurs in a depth of not less than 4"; do not obtain from bogs or marshes. All topsoil is to be tested and analyzed by an independent laboratory before delivery to site, as indicated in Article 3.03.
7. Contractor shall provide the Architect with location of soil, crops previously planted on such soil within the last two years, and the USGS soil survey classification and name.
8. Trees, Shrubs and Plants: Provide trees, shrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1-1980 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free from disease, insects, insect eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, overlapping surface roots, or disfigurement. Central leaders of all trees shall be intact, undamaged, with evenly spaced lateral branches.
 - a. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
9. Label all trees and shrubs with securely attached waterproof tag bearing legible designation of botanical and common name. Where formal arrangements and consecutive order of trees is shown, select stock for uniform height/spread, and label with number to assure symmetry in planting.
10. Stock Review: The Architect will review trees and shrubs at site before planting with requirements for genus, species, variety, size and quality. The Architect retains right to further review trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of the work. Remove rejected vegetation immediately from project site. Contractor shall request review of such stock by the Architect by delivering notice, in writing, 72 hours in advance.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver exterior plants freshly dug.

- B. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- C. Packaged Materials: Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.
 - 1. Protect plants from sun or drying winds. Protect and maintain plants that cannot be planted immediately upon delivery.
 - 2. Do not drop plant material.
 - 3. Do not pick up container planter material by stems or trunks.
 - 4. Protect from wind.
 - 5. Water as required.
 - 6. Do not prune trees and shrubs before delivery except as approved by Architect. Do not bend or bind trees or shrubs in such manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery, and provide protection on site from traffic, pedestrians, and deleterious effects of climate while planting operations are in progress. Dropped or damaged stock will not be accepted.
 - 7. Deliver trees and shrubs after preparations for planting have been completed and plant immediately after approval of plant materials locations. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture. Do not remove container grown stock from containers until planting time.
 - a. Do not pick up plants by stems or truck. Handle planting stock by root ball.
 - b. Do not remove container - Grown stock from containers before time of planting.
 - c. Water root systems of exterior plants stored onsite with a fine-mist spray.
 - d. Water as often as necessary to maintain root systems in a moist condition.
 - 8. Plant material shall not be stored on the jobsite for more than 48 hours before planting. Contractor shall schedule nursery deliveries in sub-groups as necessary to comply with this requirement.
 - 9. Deliver accessory materials in manufacturer's original, unopened packaging with identifying labels affixed and legible in accordance with state law. Deliver plants with identifying tags affixed. Contractor shall notify Architect 72 hours in advance of plant material delivery for observation. Review plants with Landscape Architect to confirm that they are the plants which had previously been tagged and supplied. The Architect reserves the right to reject the following:
 - a. Plant materials not identifiable as previously selected.
 - b. Materials not accompanied by required certificates.
 - c. Plant materials where damage to rootball, trunks, or desiccation of leaves has been caused by inadequate protection during delivery.
 - d. Plant material not matching the form, shape, or growth habit required for the design intent of the Project.
 - e. Horticultural or visual defects in material.

- f. Plant material pruned prior to delivery.
- g. Plant material with detrimental pests.

1.8 PROJECT CONDITIONS

- A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
 - 1. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of substantial completion.
 - a. Plant or install materials during normal planting seasons for each type of landscape work required.
 - 2. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed without having detrimental effects on the plant material, or finished product.
 - 3. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
 - a. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.
 - 4. Contractor shall verify locations of all existing utilities, whether shown on plans or not. The Contractor shall notify members of Underground Service Alert (DigAlert) two (2) working days in advance of performing any excavation work by calling the toll-free number 1-800-227-2600 or 811.
 - 5. After determining location of underground utilities, perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
 - 6. When conditions detrimental to plant growth are encountered, such as rubble fill, hardpan condition, adverse drainage conditions, or obstructions, notify the Architect before planting. Remove all material deemed unsuitable for plant growth as directed by the Architect.
 - 7. No landscape materials may be planted before an irrigation operation and coverage test is completed by the Architect.
 - 8. No landscape materials may be planted before finish grade is reviewed by the Architect.
 - 9. Existing Trees:
 - a. Prior to the beginning of any clearing, grubbing, trenching, or excavation on site, the general contractor, grading contractor, project arborist, landscape contractor, and the Architect shall meet in a pre-construction conference to discuss grading near existing trees.
 - b. The contractor shall protect all existing trees and shrubs scheduled to remain against injury or damage, including cutting, breaking or skinning of roots, trunks or branches. No blasting of rock shall occur in any area adjacent to existing trees without prior written consent of the Architect.
 - c. No trees or shrubs are to be removed, trimmed, or cut without prior approval of the Architect.

- d. Prior to the beginning of the clearing and grading phase of the project, a continuous, temporary, six foot (6') high chain link fence shall be erected around the drip line of all trees scheduled to remain, unless otherwise specified by the Architect. The temporary fencing shall be erected prior to commencing any other work on the project. No construction activity shall be allowed within the limits of this fencing unless directed by the Architect. The temporary fencing shall remain in place during the entire construction period and shall not be removed until directed by the Architect.
- e. Grading beneath trees to be saved shall be given special attention. Every effort shall be made to avoid creating conditions adverse to the tree's health. The natural ground within the drip lines of trees to be preserved shall remain as undisturbed as possible. Grading within the protected root zone of trees to be preserved will not be permitted unless specifically approved by the Architect prior to beginning of proposed grading.
- f. If during construction or grading (grading, excavation, etc.) tree roots of 2" in diameter or greater are encountered, work shall stop immediately and a Certified Arborist, approved in advance by the Architect, shall be contracted for a root inspection. Root cutting of any roots over 2" in diameter must have prior approval from the Architect. All cuts are to be made with appropriate equipment, as to not affect the plant material.
- g. Major roots one inch (1") or greater in diameter encountered within the drip line of the tree in the course of excavation or trenching shall not be cut and shall be kept moist and covered with earth as soon as possible. Shredding of roots or damaged caused by trenching or grading equipment is not permitted.
- h. Roots one half inch (1/2") to one inch (1") in diameter which are severed shall be trimmed cleanly and covered with earth as soon as possible.
- i. All trenching beneath the drip line of trees to remain shall be done with hand tools only. No mechanical trenching or excavation is allowed within the drip line of existing trees at any time, or where roots are encountered outside the dripline of the tree.
- j. Branches interfering with construction but not designated for removal may be removed only as directed by the Architect.
- k. Any pruning, cutting, or trimming of any trees will be performed by an International Society of Arboriculture Certified Arborist or certified tree worker or in accordance with the National Arborist Association and/or International Society of Arboriculture pruning standards. Cutting of 2" diameter limbs or greater or major dead wooding shall require approval of the Architect.

- l. Trees or shrubs scheduled to remain and damaged by construction operations shall be repaired by the contractor in a manner acceptable to the Architect. Damaged trees and shrubs shall be repaired promptly to prevent progressive deterioration. Repair or replacement of trees and shrubs shall be at the contractor's expense as determined by the Architect. Contractor shall be held fully liable for damage caused to trees and shall be assessed fees based on the International Society of Arboriculture "Guide for Plant Appraisal", as determined by the project Arborist; fees will be assessed for: 1) any injury to the trunk, limbs, or root system, and (2) for the value of any tree requiring removal subsequent to injury or treatment that varies from these Specifications.
- m. A permit from the City Arborist may be required prior to pruning or removing any trees, as required by applicable codes or ordinances.
- n. Parking of vehicles, equipment or storage of materials under the drip line of existing trees shall not occur at any time.
- o. Wash all existing and new trees weekly to remove dust and debris during construction.

1.9 SCHEDULING

- A. Within 30 days after the commencement of initial grading, furnish documentation to the Architect that all plant material has been secured for the project and is available. Contractor shall be responsible for payments and deposits required by the grower or plant consultant to secure, maintain, and grow plant material indicated on the Contract Drawings.

1.10 WARRANTY

- A. Special Warranty: Warrant all plant material in writing where installer agrees to repair or replace plantings and accessories that fail in materials, workmanship or growth within specified warranty period.
 1. Failures include, but not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, abuse by owner.
 - b. Structural failures including plantings falling or blowing over including during high wind events.
 - c. Faulty operation of tree stabilization edgings tree grates.
 - d. Deterioration of metals, metal finishes and other materials beyond normal weathering.
 - e. Material not thriving.
 - f. Warranty periods begin from date of final completion:
 - 1) Trees, vines, shrubs: One year.
 - 2) Ground cover and turf: One year.
 2. Warrant plant material, installed, or relocated under the contract, in writing, for a period of one year (after beginning of maintenance period) against defects including death, and unsatisfactory growth, except for defects resulting from neglect, abuse or damage by others.

3. Remove and replace trees, shrubs or other plants found to be dead, yellowing, defoliating, or in unhealthy condition, or other defective materials during warranty period at no additional cost to the Owner. Replace trees and shrubs, which in the opinion of the Architect, are in unhealthy condition at end of warranty period. The Architect shall be the sole judge as to the condition of the material. All replacement materials and installation shall comply with the drawings and specifications. Another inspection may be conducted at end of warranty period to determine acceptance or rejection.
4. Upon receipt of written notice from Owner of the loss of any warranted plant materials during the warranty period, the subject plant materials shall be promptly replaced with the same species originally planted, and of a size closely approximating the size of the plant, if normal growth had occurred since the original planting. Replacements shall be subject to the requirements of this specification.
5. When plants are replaced, advise the Owner, in writing, of the new establishment maintenance period equal to the one year.
6. Plant material must be replaced within ten (10) days of written notification, and shall be installed in accordance with these specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Design is based on the use of products manufactured by the following.
- B. California (Southern)
 1. Stabilizer, Inc. Phoenix, AZ 800-325-5360.
 2. Conwed Designscape, Ladyscape, MI, 714-532-5548/800-833-4798.
 3. MacLean Civil Products, Fort Mill, SC 800-925-5360.(check for local distributor)
 4. Agrono-Tec Seed Co., Wildomar, CA, 800-543-4109.
 5. Peach Hill Soils, Moorpark, CA, 805-529-6164.
 6. Aguiñaga Fertilizer Co., Inc., Irvine, CA, 949-786-9558.
 7. Ecology Controls, S&S Seeds, Camarillo, CA, 805-684-0436.
 8. Gail Materials, Corona, CA, 951-664-6106.
 9. KRC Rock, San Marcos, CA, 800-427-0572.
 10. Landscape Forms, represented by
 - a. David Silverman & Associates, 818-541-6691.
 11. Mirafi, Inc., Charlotte, NC 800-438-1855, represented by James Heidt & Associates, Montrose, CA, 818-248-9677/800-233-0512.
 12. NDS Drainage Products, 800-726-1998.
 13. Quality Turf, Temecula, CA, 800-721-4800.
 14. Pacific Sod, Camarillo, CA, 800-762-3027.
 15. Permaloc Corporation, Holland, MI, 616-399-9600.
 16. S&S Seeds, Camarillo, CA, 805-684-0436.
 17. Soil and Plant Laboratory, Inc., Orange, CA, 714-282-8777.
 18. Southern California Organic Fertilizer Company, El Monte, CA, 714-750-3830.

19. Southland Sod Farms, Port Hueneme, CA, 805-488-3585.
20. V.I.T. Company, Escondido, CA, 760-480-6702.
21. West Coast Turf, Las Vegas, NV, 800-649-8873.
22. Whitecap, Inc., Santa Ana, CA, 714-258-3300.
23. Whittier Fertilizer, Pico Rivera, CA, 310-699-3461.
24. EPIC Plastics, Cerritos, CA, 562-403-3848.
25. Wallace Labs, El Segundo, CA, 310-615-0116.
26. Materials shall be the products of one manufacturer and shall be either the ones upon which the design is based, or the products of manufacturer accepted in advance. No substitutions will be permitted.

2.2 SOIL

- A. TOPSOIL: Site to be rough graded to elevations shown on Civil Drawings. Topsoil will be required behind curb areas and in planting area. Provide on-site, import, or non-processed topsoil in planting areas as needed to complete rough grading which is fertile, friable, and natural loam in accordance with Article 2.3. Topsoil shall be from agricultural sources, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 3/4-inch in any dimension, and other extraneous or toxic matter harmful to plant growth.
- B. All topsoil to be used for planting, regardless of whether import or on-site in origin, shall be tested as described in Part 3 of this Section.
- C. Root zone for sand based turf and materials.
 1. Pre-manufactured soil by Gail Materials.
 2. Sand: Refer to detail on approved plans for depth
 - a. Meet the following gradation:

Sieve No.	Percent Passing (by weight)
3/8 inch	100
8	75-100
16	40-100
30	0-50
50	0-12
100	0-5

- b. Chemistry
 - 1) Salinity: Saturation extract conductivity (ECe) shall be less than 3.0 dS, @ 25 degree C.
 - 2) Sodium: Sodium absorption ratio (SAR) shall be less than 6.0.
 - 3) Boron: Saturation extract concentration shall be less than 1.0 ppm.
 - 4) Reaction pH of saturation paste shall be 5.5 to 7.8 without height lime content.

3. Bark: 1 to 1/4 inch fir or pine bark. Refer to planting details for depth.

- a. Particle Size Distribution:

Sieve No.	Percent Passing
3/8 inch (9.51mm)	100
1/4 inch (6.35mm)	95
0.02 inch (500 micron)	0-30

- b. Minimum 90 percent organic by dry weight as determined by ash method.
- c. pH shall be in the range of 4.0-5.5 as determined in saturation paste.
- d. Salinity shall not exceed 2.0 dS/m as determined in saturation extract.
- e. Dry bulk density shall be in the range of 400 to 580 pounds per cubic yard.
- f. Fir or pine sawdust or greenwaste compost are not acceptable alternatives.
4. Soil Mixture: The soil mixture shall be a bind of one part 0-1/4 fir or pine bark and 6 parts of specified sand. Refer to approved details for depth. The following amendments shall be added and uniformly blended at tan offsite facility (equal to Gail Materials) into the sand bark mixture prior to placement on the field.
- a. Nitroform (38%N, 27% WIN): 2/3 pound
- b. 6-20-20 Commercial Fertilizer: 1 pound
- c. Solomitic Limestone (Kaiser AG 65): 1.5 pounds
- d. Iron Sulfate (31% Fe): 5 ounces
5. Location(s)
- a. Use in designated field areas.
- b. Depth shall be per details.
- c. Available through Gail Materials, Corona, CA (951) 667-6106
- d. Contact: Dave Dzwilewski

2.3 SOIL AMENDMENTS

- A. The initial application of fertilizers and amendments to be tilled into the soil during soil preparation operations shall be established after soil testing has been conducted by Contractor. An estimated quantity is indicated below for bid purposes only. This estimated quantity does not include mulching, fertilizer tablets, additional topsoil necessary to meet specified grades and fertilizer applications for after planting. After soils analysis recommendations are made to the Architect quantifying the actual amount of amendments required and recommendations have been accepted by the Architect, the Contractor shall, without delay, determine any cost impacts whether credit, no change, or addition, to the Contract Amount. As an integral part of the bid for Landscape Work, provide a Lump Sum bid amount for fertilizers and amendments as described below.
- B. Application Rates (FOR BID PURPOSES ONLY):
1. Sixty (60) lbs. of Tri-C Humate per 1,000 square feet.
 2. Nineteen (19) lbs. of 6-20-20 fertilizer per 1,000 square feet.
 3. Six (6) cubic yards of Aguiñaga GPS2, nitrogen stabilized compost per 1,000 square feet.
 4. 50-lbs Agricultural Gypsum, per 1,000 square feet.

- C. Pot or Raised Planter Soil Mix: Prepare and backfill pots with a mix of the following per cubic yard:
1. Jardinier Capillary Soil
 2. 12-12-12 Commercial Fertilizer
 3. Organic Amendment - 1/3 cubic yard
 4. Fine Sand - 1/3 cubic yard
 5. 12-12-12 Commercial Fertilizer - 1 pound
 6. Iron Sulfate - 2 pounds
- D. Actual amendment rates and type shall be per soil test recommendations.
- E. Imported Topsoil
1. Provide natural, fertile, friable soil free from stones, noxious weeds, seeds, roots, subsoil or other material detrimental to normal plant growth. Topsoil acidity range (pH) shall be between 6.5 and 7.5 containing a minimum of 4 percent and a maximum of 25 percent organic matter.
 2. Reuse surface soil stockpiled onsite. Verify suitability of stockpiled surface soil to produce top soil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - a. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain top soil displaced from naturally well drained sites where topsoil occurs at least 4 inches deep; do not obtain from [agricultural land], bogs or marshes. Obtain soil from local sources acceptable to the Architect.
 - b. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2 millimeter sieve.
 3. Obtain imported topsoil from local sources acceptable to the Architect.
 4. Silt plus clay content of soil shall not exceed 15 percent by weight with a minimum 95 percent passing a 2-millimeter sieve.
- F. Organic soil amendment:
1. "Nitrified Redwood Compost": 0.56 to 0.84% N based on dry weight, treated with relative form of nitrogen (NH₃).
 - a. Particle Size
 - b. 95% - 100% passing 6.35 mm standard sieve.
 - c. 80% - 100% passing 2.33mm standard sieve.
 - d. Salinity: The saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees (25N) centigrade as determined by saturation extract method.
 - e. Iron Content: Minimum 0.08% dilute acid soluble Fe on dry weight basis.
 - f. Ash: 0 - 6.0% (dry weight)
 - g. Acidity range (ph) shall be between 5.5 and 7.5.
 - h. Actual organic content shall be a minimum 280 pounds (lbs.) per cubic yard.
 - i. As available from: Redi-Grow Corporation, 909 Elder Creek Road, Sacramento, CA 95828

2. Organic soil amendment shall be Aguinaga GPS2.
3. Particle Size:
 - a. 90-100 percent passing 6.35 mm standard sieve.
 - b. 80-100 percent passing 4.75 mm standard sieve.
4. Salinity: The saturation extract conductivity shall not exceed 6.5 milliohms/centimeter at 25 degrees Centigrade as determined by saturation extract method.
5. Iron Content: Minimum 0.08 percent dilute acid soluble iron on dry weight basis.
6. Actual organic content shall be a minimum of 280 pounds (lbs.) per cubic yard.

G. Fertilizers

1. Tri-C Humate. Provide per manufacturers specification.
2. Fertilizer Tablets: Fertilizer Tablets: The following is to be used in the planting of container grown material. Follow manufacturer's application rates.
 - a. Best-Paks "20-10-5" fertilizer packets. Packets to be made up of a minimum of 20% Nitrogen, 10% Phosphorus, 5% Potash. Use 1 Pak per 1-gallon container, (G.C.), 3 Paks per 5 G.C., 9 Paks per 15 G.C. and 12 Paks per boxed specimen. Evenly distribute as shown in details.
3. Commercial Fertilizer: First Quality Commercial Fertilizer, as specified in Agronomic Soils Report.

H. Related Materials:

1. Pre-Planting Herbicide: Phydura, or equal.
2. Pre-Emergent Weed Control: Ronstar-G, Treflan, Eptam, Vegetex, or equal.
3. Peat Moss: Sphagnum peat moss, Canadian or European variety, free from alkali.
4. Soil Sulfur: First quality commercial grade.
5. Ferrous Iron Sulfate: Chelated first quality commercial grade.
6. Agricultural Gypsum: First quality commercial grade.
7. Best "Ammonium Phosphate" 16-20-0 with net less than 16% total nitrogen, 20% available phosphoric acid and 0% soluble potash.
8. Good Humus.
9. Root Hormone: Super Thrive.

2.4 PLANT MATERIALS

- A. Quality: Provide trees, shrubs, and other plants of size, form, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".
- B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
 1. Lateral scaffolds shall be radially distributed around the trunk. The lateral branch shall be no more than 2/3 the diameter of the trunk. Trunk to be measured 1" above the branch (lateral scaffold).

2. The minimum acceptable length of the most recent season's shoot growth for slow growing trees shall be not less than 8"; for fast growing trees not less than 12".
3. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.
4. Needle Leafed and Broad Leafed Evergreen Trees: Provide evergreens of sizes shown or listed. Where dimensions are shown, they indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
 - a. The minimum acceptable height of trees is 6'-0" when planted, or as determined by Architect.
5. Multi-Trunk Trees: Provide sizes shown or listed. Tree is to have a minimum of three (3) dominant trunks with appropriate caliper size and adequate spread.
6. Shrubs: Provide shrubs of the size shown and with not less than the minimum number of canes required by ANSI Z60.1 for type of shrub required. Provide container grown stock.
7. Ground Cover: Provide plants established and well-rooted in removable containers, in flats, or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the size shown or listed.
8. Vines: Provide vines with good, well-established root systems within the container, and devoid of any abrasions, and or damage to stem.

2.5 SOD

A. Lawn Sod:

1. Nursery-grown sod shall have the following characteristics:
 - a. Sod for planting areas shall be dense, healthy, field-grown on sand fumigated soil with the grass having been mowed at 1-inch height before lifting from field.
 - b. Sod for grass pave areas shall be dense and healthy, grown on a sand bed thin cut and washed.
 - c. Sod shall be dark green in color, relatively free of thatch, free from disease, weeds and harmful insects.
 - d. Sod shall be reasonably free of objectionable grassy and broadleaf weeds. Sod shall be considered weed free if no more than 2 such weeds are found per 100 square feet of sod.
 - e. Sod shall be rejected if found to contain the following weeds: common Bermuda grass, quack grass, Johnson grass, nimble weed, thistle, bindweed, bentgrass, perennial sorrel, and brome grass.
 - f. Sod variety shall be:
 - 1) Turf Grass: Tiffway II, Bullseye, Bandera, GN1, Medallion Plus 90% Tall Fescue/10% Bluegrass Blend, as produced by West Coast Turf / Pacific Sod.
 - 2) Molate Fescue: No Mow Fine Fescue Blend, as produced by Pacific Sod.

2.6 MISCELLANEOUS LANDSCAPE MATERIALS:

- A. Tree Stakes: Provide stakes of sound new lodgepole pine 2 inch minimum diameter for 15 gallon to 24 inch box size trees; 3 inch minimum diameter for 36 inch box and larger. Lodge pole minimum height, as indicated on Contract Drawings. Stakes shall have been treated with copper naphthanate or ACQ (alkaline) or Ca-B (copper azole) to a minimum wood depth of 1/16". All stakes shall be free of knots larger then 1/2" in diameter, holes and other defects.
- B. Tree Straps: Provide VIT black tree straps. Tree straps shall be attached to tree stake as shown in staking detail on the plans, color to be black.
 - 1. VIT "Cinch-Tie" for 24-inch box size and smaller tree.
 - 2. VIT "Cinch-Belt" for 36-inch box size and larger tree.
- C. Vine Ties: Plastic vine ties, as specified on plans.
- D. Headers and Edging
 - 1. Concrete edger: Dimension as specified on plans, poured in place concrete edger, color per plan.
- E. Mulch
 - 1. Bark Mulch:
 - a. Mulch shall be Walk-On bark mulch, as manufactured by Peach Hill Soils, Moorpark, CA.
 - 1) Mulch shall consist of shredded Douglas Fir bark mulch with a particle range of 2-3/4-inch to 1-inch in size.
 - b. Mulch shall be Walk-On Bark
 - 1) As available from Redi-Grow Corporation, Sacramento, CA.
 - 2. Weed Control Fabric: Place Mirafi Mirascape landscape fabric below rock mulch or as shown on drawings. Overlap all seams 12" minimum and pin down every 36" typical. Mirascape fabric available from: Towns & Associates, 800-222-6036
- F. Root Control Barriers: High-density polypropylene root control planter. Acceptable products include:
 - 1. Deep Root; Deep Root Corporation.
 - 2. Size as specified on drawings.
- G. Drainage Materials
 - 1. Gravel in raised planters on structural slab and in pots shall be clean, coarse 3/8-inch to 3/4-inch diameter.
 - 2. Gravel for tree drainage shall be 3/4" diameter coarse clean gravel.
 - 3. Synthetic filter membrane cover over drainage course shall be woven synthetic fabrics.
 - a. Model 140N, as manufactured by Mirafi.

- 4. Drain Pipe at trees: 4-inch diameter PVC perforated(within gravel), and non-perforated PVC drain pipe(stand pipe) with PVC adaptor connected to 4-inch ABS female reciever with 4-inch black ABS cleanout plug.
- H. Sand: Washed plaster sand.
- I. Jute Netting: A uniform open plan weave, single jute yarn not varying in thickness by more than 1/2 of its normal diameter, in rolled strips approximately 50 to 75 yards long and 50 to 60 inches wide. Contractor shall submit sample for approval prior to installation.
- J. Staples: 11 gage with 1-inch top and 6-inch legs.
- K. Weed Control: Phydura, or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected, and Architect has reviewed and accepted materials as defined within the section.

3.2 SITE OBSERVATION SCHEDULE

- A. General: Notify Landscape Architect at least 3 days in advance when requesting on-site reviews.
- B. Prior to commencement of site visits, items noted in previous observation reports shall have been either completed or remedied, unless such compliance has been waived. Failure to complete prior tasks or failure to prepare adequately for scheduled observations shall obligate Contractor to reimburse Architect for additional hourly services, plus transportation costs
- C. Schedule For On-Site Reviews by the Landscape Architect:
 - 1. Pre-construction conference with general contractor, grading contractor, landscape contractor, project arborist and landscape architect to discuss grading and protective measures to be followed in the vicinity of existing trees, or existing structures.
 - 2. At completion of finish grading, and roto-tilling
 - 3. Review of irrigation coverage prior to installation of any planting material.
 - 4. At completion of fine grading and at delivery of plant materials, together with plant layout; prior to excavating pits.
 - 5. Review of drainage system, standpipes, and plant material locations.
 - 6. After planting pits have been excavated, but prior to backfilling. Provide one sample plant pit mock up for review.

7. After initial planting operations (One tree with each type of specified staking shall be approved prior to planting of trees).
8. Stake all tree locations for review.
9. See "Final Review and Acceptance" at the end of Part 3 in this Section for final site observations and acceptance of work.

3.3 TESTING

A. Planting Soil: Agronomic Soil Testing

1. Test shall be paid for by the Contractor. (SoCal)Testing lab shall be:
 - a. Wallace Labs, El Segundo, CA
 - b. Waypoint Analytical, Anaheim, CA
2. Agronomic Soils Testing
 - a. Take five (5) samples of site soil at a depth of 6 to 12 inches, within proposed planting areas, after completion of final grading and prior to weed control and soil preparation.
 - b. Take samples to agronomic soils testing laboratory indicated above for soil evaluation.
 - c. Request testing for fertility and suitability analysis with written recommendations for soil amendment, fertilizer and chemical conditioners, application rates for soil preparation, planting backfill mix, pot-soil mix, hydro-spray, and post-maintenance fertilization programs.
 - d. Soils report recommendations shall take precedence over the amendment and fertilizer application rates specified in this section.
 - e. Submit testing laboratory's interpretation, recommendations, and comments to Architect within 14 days after the completion of rough grading.
 - f. Furnish a soils analysis of import soil, and organic soil amendment prior to backfill.
 - 1) Submit soil testing laboratory's findings to Architect within 5 days prior to backfilling.
 - g. Take six additional soil samples after completion of planting in the soil preparation and backfill mix areas, to be determine effectiveness to amendments prior and during planting. Submit to the testing laboratory the original amendment specification with previously issued bulletins for soil amendments and installation procedures. Re-apply necessary amendments based on recommendation of new soils test.

3.4 PREPARATION

A. Final Grades

1. Finished grading shall insure proper drainage of the site. Conform to Division 31 Section "Earthwork" and Division 32 Section "Landscape Grading."
2. The following areas shall be graded so that the final grades shall be established below adjacent paved areas, sidewalks, valve boxes, headers, clean outs, drains, manholes, etc. before placement of mulch as follows:
 - a. Shrub/Groundcover Areas: 2-1/2 inches.

- b. Turf areas: 1-inch.
 - c. Surface drainage shall be away from all building foundations, 2% minimum.
 - d. Dispose of excess or unacceptable soil from the site at no expense to the Owner.
 - e. Verify that final grades have been established prior to beginning planting operations.
3. Parking Lot Planters and areas adjacent to hardscape.
 - a. All aggregate base rock, lime-treated soil, soil sterilents, and other non-organic materials shall be removed from all parking lot planter areas down to the level of native soil. Scarify native soil to a depth of 12 inches and backfill planters to specified finish grade with native or approved topsoil and amend as specified.
 - b. Remove all concrete overpours or any material that may prohibit the placement of plant material, irrigation, grates, root barriers, or any other conflicting material.
4. Lightweight soil mix shall be sampled after mixing and delivery to the site, but prior to filling planters. Submit the original lightweight soil specification to the testing laboratory with previous bulletins for lightweight soil mix. Provide 1-quart of lightweight soil mix for every 65 cubic yards for organic and fertility analyses. Fertility analysis, recommendations and interpretations shall be furnished by the testing laboratory to ensure all specified amendments have been provided. Lightweight soil is to be used only in locations indicated on the Contract Drawings and as approved by the Architect.
5. Protect planting areas from compaction by foot, trucks and heavy equipment.

3.5 PLANTING BED ESTABLISHMENT

A. Preparation Of Planting Area

1. Cross-rip on-grade planting areas to a minimum depth of 12 inches minimum 2 perpendicular directions. Remove stones over ½ inch (13mm) in any dimension and sticks, roots, rubbish and other deleterious matter per Division 32 "Landscape Grading".
2. Where additional soil is needed, place the top 15" with topsoil. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
3. Leach soil prior to amending.
4. After approximate finished grades have been established and soil has been leached, soil shall be conditioned and fertilized in the following manner: Soil condition shall, at the rate specified in the approved soils test recommendations, be uniformly spread and cultivated thoroughly by means of mechanical tiller into the top (8) eight inches of soil.
5. Broadcast soil amendments uniformly over surface of the area to be treated. Roto-till the top (8) eight inches of planting areas to evenly distribute the amendments and conditioners into the soil.
6. Retest as required to verify leaching was successful. All soil areas shall be compacted and settled by application of irrigation to a minimum depth of six (6) inches prior to any plant materials being installed.
7. At time of planting, the top 12 inches of all areas to be planted shall be free of stones, stumps, or other deleterious matter one 1/2 inch in diameter or larger, and shall be free from all debris, or similar objects that would be a hindrance to planting and maintenance.
8. Weed Eradication:
 - a. Manually remove all existing vegetation in planting areas and dispose of it offsite.

- b. Fertilize planting areas with urea 30-0-0 commercial fertilizer at the rate of 0.5 pounds per 1000 square feet.
 - c. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck, or other) for a period of 3 consecutive weeks, or until the weed seed have germinated. If accepted in advance by the Landscape Architect, employ a specific watering duration and frequency program designed to germinate residual weed seeds.
 - d. Discontinue watering process for 2 days. Then apply a non-selective broad spectrum systemic herbicide for perennial weeds. (2 applications minimum) The type of herbicide to be used shall be determined by a licensed pest control applicator. If annual weeds are present, use straight contact herbicide in accordance with pest control applicator's recommendations.
 - 1) Do not use a pre-emergent herbicide.
 - e. Allow sufficient period of time to ensure that weeds are dead. Follow herbicide manufacturer's directions.
 - f. Water planting areas thoroughly and continuously (by irrigation system, hand/hose, water truck or other) for a period of 3 weeks. A shorter watering period may be permissible at the discretion of the Landscape Architect. Discontinue watering process for 1 day prior to the second application of the herbicide spraying. (2 applications minimum) Re-apply the spraying operation with straight contact weed killer in accordance with pest control adviser's recommendations.
 - 1) Do not use a pre-emergent herbicide.
 - 2) Avoid irrigation for a minimum of 4 days for effective final weed kill.
 - g. Clear desiccated weeds from the area.
 - h. Water Planting areas thoroughly and continuously for 3 consecutive days to saturate upper layers of soil prior to planting operations.
 - i. Allow planting area soil surface to dry out for 1 day only prior to the planting application. Exercise care to not allow the soil surface to be either super-saturated with water or bone dry prior to the planting installation. Ensure moderate residual moisture within the top 1/4 inch of the soil surface.
 - j. The hydraulic equipment used for pesticide applications shall consist of an ISO-gallon minimum capacity fiberglass tank with complete mechanical agitation. The pump capacity shall be 10 gallons per minute while operating at a pressure of 100 pounds. Per square inch.
 - k. Distribution lines shall be large enough to carry the volume of water necessary for even, chemical distribution. The spray nozzle must cover a 15-foot swath, with a minimum output of 5 gallons per minute at 80 pounds per square inch.
9. Pre-emergent Weed Control: Immediately after planting, apply pre-emergent weed control to planted areas which will not be seeded.
10. Excavation For Trees And Shrubs
- a. Excavate pits, beds, and trenches as shown in details on the drawings.

3.6 JUTE MESH

- A. Make check slots before the netting is rolled out. Dig a narrow trench across the slope perpendicular to the direction of the flow. Fold jute, the same length as the trench, and press together. Location of check slots shall be a maximum of 50 feet apart.
- B. Installation: Roll netting parallel to slope contours. The netting shall completely cover all areas as indicated on Contract Drawings. Overlaps shall be ample and well stapled.
 - 1. Lay netting smoothly, and in continuous contact with the soil surface at all points.
 - 2. Install without stretching. Where one roll of netting ends and a second roll starts, the up slope piece shall be brought over the buried end of the second roll so that there is a 12-inch overlap. Where two or more widths of netting are applied, side by side, the overlap shall be not less than 3 inches.
 - 3. Staple overlapping edges that run parallel to the direction of the flow at 2-inch intervals. Outside edges, centers, and overlaps on banks shall be stapled across the slope at 6-inch intervals.
 - 4. Top dress jute netting area with a thin layer of topsoil. After the top dressing, the yarns shall still be visible.
 - 5. Spread loose topsoils over outside edges of netting to allow for smooth entry of water.
 - 6. Clods that hold the jute off the ground shall be stamped into the soil. Force jute netting down into depressions and hold there with a staple.
 - 7. Install plant material through netting.
 - 8. Maintenance: Maintain jute netting until work on the Project has been completed and accepted and during the 90-day maintenance period. Maintenance shall consist of the repair of eroded areas and the repair or replacement and re-stapling of loose or undermined netting. Replace damaged planting materials as required.
 - 9. Install jute netting in all areas of 30 percent slope or greater.

3.7 HYDRO-MULCH / HYDRO-SEED

- A. Examination:
 - 1. Verify that soil is prepared and fine graded in accordance with Division 32 "Finish Grading."
 - 2. Verify that large trees and shrubs (5-gallon and larger) are installed if they occur in hydroseeded area.
 - 3. Verify that small trees and shrubs (1-gallon) and groundcover from flats are installed if they occur in hydroseeded area.
- B. Hydroseeding Operation:
 - 1. Before filling tanks, completely clean tank of seed and debris in the presence of, and to the satisfaction of, the Architect.
 - 2. Mixes shall be as indicated in Plant Legend on Contract Drawings.
 - 3. Hydroseeded areas shall be applied by an approved hydromulch company.

4. The hydromulch shall be applied in the form of a slurry, consisting of cellulose fiber, seed, chemical additives, commercial fertilizer, and water. When hydraulically sprayed on the surface, the hydromulching shall form a blotter-like groundcover impregnated uniformly with seed and fertilizer and shall allow the absorption of moisture and rainfall to percolate to the underlying soil.
- C. Preparation: The slurry preparation shall take place at the site and shall begin by adding water to the tank when the engine is half throttle. When the water level has reached the height of the agitator shaft, full re-circulation shall be established. At this time, the seed shall be added, followed by fertilizer and then mulch.
 1. The mulch shall only be added to the mixture after the seed and the tank is at least one-third filled with water. The mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is full.
- D. Application: The operator shall spray with a uniform visible coat by using the green color of the mulch as a guide. The slurry shall be applied in a sweeping motion, in an arched stream, so as to fall like rain allowing the wood fibers to build on each other until a good coat is achieved and the material is spread at the required rate per acre.
- E. Time Limit: Slurry mixture that has not been applied within 2 hours after mixing shall be removed from the project and disposed of in a legal manner.
- F. Daily work sheets shall be prepared by nozzlemen. One copy shall be sent to the Architect. This worksheet shall be signed by the nozzleman and the Architect. The following information shall be indicated:
 1. Seed: Type and amount.
 2. Fertilizer: Analysis and amount.
 3. Mulch: Type and amount.
 4. Binder/Stabilizing emulsion: Type and amount.
 5. Seeding Additive: Type and amount.
 6. Loads: Number.
 7. Water: Amount.
 8. Coverage: Area in acres.
 9. Equipment Used: Capacity and vehicle license number, if applicable.
- G. Protection: Special care shall be exercised by the Contractor in preventing any of the slurry from being sprayed inside reservoir basin or into drainage ditches and channels that may impede the free flow of rain or irrigation water.
- H. Immediately following application of hydromulch, the Contractor shall wash excess material from previously planted materials and architectural features. Care shall be exercised to avoid washing or eroding mulch materials from area.
- I. Slurry spilled on restricted areas shall be cleaned up immediately.

- J. Equipment: Hydraulic equipment used for the application of the fertilizer, seed and slurry of prepared wood pulp shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing not less than 40 pounds of fiber mulch plus a combined total of 7 pounds fertilizer solids for each 100 gallons of water.
 - 1. The slurry distribution lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles that will provide a continuous non-fluctuating discharge. The slurry tank shall have a minimum capacity of 1500 gallons and shall be mounted on a traveling unit, either self-propelled or drawn by a separate vehicle that will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded.
- K. Apply slurry at the rate of 12 pounds per acre, mixed with commercial fertilizer at 600 pounds per acre. Mix the specified seed material with water and spray, resulting slurry under high-pressure and evenly, and uniformly over area to be seeded

3.8 PLANTING

- A. General
 - 1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Architect.
 - 2. Only as many plants as can be planted and watered on that same day shall be distributed in a planting area.
 - 3. Container shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.
- B. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure acceptance by the Architect before start of planting work. Make minor adjustments as may be requested.
- C. Excavation for Trees and Shrubs:
 - 1. Excavate pits, beds and trenches as shown in details on the Drawings.
 - 2. Roughen and score edges of planting pit to eliminate any glazing of the sides of the pit.
 - 3. Field Samples: Prior to planting, prepare one plant pit with standpipe, gravel, filter fabric, and root barriers for each tree size to be reviewed by the Architect.
 - 4. Do not cover standpipes.
 - 5. Excavation for planting shall include the stripping and stockpiling of all acceptable topsoil encountered within the areas to be excavated for trenches, tree pits, plant pits, and planting beds.
- D. Container Removal
 - 1. Cut containers on two sides with an acceptable cutter. Do not cut containers with spade or ax. Do not injure the rootball.

2. Carefully remove plants from containers without injury or damage to rootball.
 3. After removing plants, superficially cut edge roots with knife on three sides.
 4. For plants with sensitive roots, place container intact in flat pit 1½ times the size of a standard plant pit. Insert blades of sharp, needle-nose shears into a drain hole and cut the container bottom away. Remove bottom from pit. Follow with a cut down one side of the container from top to bottom. Repeat cut on opposite side. Fill plant pit with prepared plant pit mixture. Carefully remove the detached pieces.
- E. Box Removal:
1. Remove bottom of planting boxes before planting.
 2. Remove sides of box without damage to rootball after positioning plant and partially backfilling.
- F. Planting Trees and Shrubs: Set container-grown stock, plumb and in center of pit or trench. Set top of rootball 2-inches above finish grade at trees, 1-inch above finish grade at shrubs, or as indicated on Contract Drawings. Do not use plant, if root system has severely kinked or circling roots, or if rootball is cracked, disturbed or broken. If root system is healthy, loosen spiraling roots and set in plant pit.
- G. Planting pit shall be backfilled with the following soil conditioner and organic amendment, per cubic yard:
1. Application Rates, (FOR BID PURPOSES ONLY) as determined by contractor's soils tests:
 - a. Potassium Sulfate - 0-0-50, ¼-pound
 - b. Single Superphosphate - 0-20-0, ¼-pound
 - c. Ammonium Sulfate - 21-0-0, ¼-pound
 - d. Compost - 15% by volume
 - e. Agricultural Gypsum - 1.5 pounds
 - f. Good Humus - 15% by volume
 2. Final amendments and rates are to be determined by Agronomic Soils Test.
- H. When set, place additional fill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 1/2-full, place appropriate number of fertilizer tablets and complete backfill operations.
- I. After backfilling, an earthen basin shall be constructed around each plant. Each basin shall be as indicated on the Contract Drawings. Basin shall be of a size suitable for the individual plant. In no case shall the basin for fifteen (15) gallon plant be less than four (4) feet in diameter; a five (5) gallon plant less than three (3) feet in diameter. The basins shall be constructed of amended backfill materials, and shall not be constructed for trees in turf areas.
- J. Repeat watering until no more is absorbed.
- K. Apply pre-emergent herbicide as per manufacturer's recommendations to all shrub and ground cover planting areas after planting.

- L. Mulch all planted areas that do not receive jute netting, other than lawn areas, at not less than 3" thickness of mulch.
 - 1. Areas with 30% slope and greater shall be protected with jute mesh.
- M. Equally space and align trees and shrubs in both directions where designated on Contract Drawings.
- N. Pull bark mulch three (3) inches away from the rootballs of all plants to insure proper air circulation.
- O. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practices. Prune trees and other plantings only if required. Pruning shall be limited to remove injured wigs and branches, and to compensate for loss of roots during transplanting, but never exceed 1/3 of the branch structure. Never prune without prior review with Architect.
- P. Prune shrubs to retain natural character. Unless directed by the Architect, do not prune leaders or apices of any plant material. Do not prune into balled or boxed forms without prior written approval of the Architect.
- Q. Remove and replace excessively pruned or malformed stock resulting from improper pruning.
- R. Planting Ground Cover
 - 1. Space plants as shown or scheduled.
 - 2. Dig holes large enough to allow for spreading of roots and compact area around plant. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
 - 3. Mulch areas between ground cover plants with not less than three (3) inch deep mulch.
- S. Miscellaneous Landscape Work: Install headers and edgings where shown. See appropriate details.
- T. Planting Vines: Plant in accordance with details. Attach vine to vertical elements with vine ties as per manufacturer's recommendations.
- U. Tree Staking and Guying: Stake or guy all trees per landscape details, and tie with tree ties as specified. Remove all nursery stakes from trees unless directed otherwise by the Architect. Immediately after planting, stake and guy all trees in accordance with details indicated on Contract Drawings. One tree of each size shall be staked and guyed, and reviewed by Architect prior to continue work.
- V. Hardpan Conditions

1. Where hardpan exists, whether it is in the form of caliche, rock or other impervious matter, and it is within the top 2½ feet of soil, or within the plant pit, use powered equipment to break through completely at each plant location to allow drainage and root growth. Remove hardpan at least 1½ feet greater than the rootball diameter of plant. Backfill with soil mix as specified.
2. Where hardpan is within the first 12-inches of soil, it shall be completely penetrated for all trees and shrubs.

3.9 CLEANUP AND PROTECTION:

- A. During landscape work, keep pavements clean and work area in an orderly condition. Haul away and remove all debris from landscape areas, and do not leave any clippings, and or other material from landscape planting and/or maintenance period.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and/or other trades. Maintain protection during installation and maintenance periods. Treat, repair or replace damaged landscape work as directed.
- C. Powerwash all pavement and flatwork as necessary to remove all staining and tire marks and provide a clean surface.

3.10 REVIEW & FINAL ACCEPTANCE

- A. General: Notify Landscape Architect at least 5 days in advance when requesting on-site reviews.
- B. Site Observation requirements:
 1. Punch list at completion of landscape/irrigation work.
 - a. Review of grading, irrigation and planting.
 - b. Upon completion of punch list items the Maintenance Period begins.
 - 1) The maintenance period will not begin until all punchlist items are resolved and acceptance is provided by the Landscape Architect in writing.
 2. Final acceptance of project (at end of Maintenance Period).
 - a. Review of grading, irrigation and planting.
 - b. Upon completion of punch list items to the Client and Landscape Architect's satisfaction, the work is deemed completed.
 3. Refer to Division 32 Section "Landscape Maintenance."
 4. Replace non-compliant and/or rejected work prior to final observation.
 5. Prior to the date of final observation, Contractor shall provide the Landscape Architect with all Record Drawings in accordance with the Plans and Specifications.

3.11 REPLACEMENT

- A. All plant material and other materials installed under the Contract shall be warranted against any and all poor, inadequate or inferior materials and/or workmanship or improper maintenance, as determined by the Landscape Architect, and shall be replaced by the Contractor at his expense. Warranty periods are noted in Part of this Specification.
1. Replacement: Any materials found to be dead, missing, or not in a satisfactory or healthy condition during the maintenance period shall be replaced immediately. The Landscape Architect shall be sole judge as to the condition of material. Material to be replaced within the guarantee period shall be replaced by the Contractor within five (5) days of written notification by the Landscape Architect. All replacement materials and installations shall comply with the Plans and Specifications.
 - a. As soon as weather conditions permit, replace work that does not comply with the Plans and Specifications, without cost to the Owner. Remove rejected and non-compliant work and materials immediately from the project. Continue specified maintenance period until reinspected by the Landscape Architect and determined to be acceptable.
 - b. Any plant missing due to suspected theft shall be replaced by the Contractor. If the Contractor suspects that theft may be a problem, the Contractor shall provide written documentation to the Landscape Architect that security on this site needs to be intensified.
 2. Contractor to schedule replacement work with the Owner's representative, and arrange for proper staging and access.
 - a. Contractor to include re-inspection dates as part of replacement work scheduling.
 3. The Contractor may relieve himself of theft responsibility if after the security notice, with no result, a written notice to the Landscape Architect shall be given that plant material will not be replaced for theft or vandalism due to lack of site security being maintained. This procedure may take place only during the Landscape Maintenance Period.

END OF SECTION 329300

DIVISION 33

UTILITIES

SECTION 331416 - SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Site water distribution system complete with valves, fire hydrants, and distribution pipelines from water supply mains to points of connection to the interior plumbing system of each building.

1.2 RELATED REQUIREMENTS

- A. Project Geotechnical Report for excavating, bedding, and backfilling.

1.3 REFERENCE STANDARDS

- A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- B. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
- C. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.
- D. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- E. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.
- F. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- G. AWWA C504 - Rubber-Seated Butterfly Valves; 2023.
- H. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2017.
- I. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- J. AWWA C800 - Underground Service Line Valves and Fittings; 2021.
- K. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.
- L. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

- M. AWWA C651 Disinfecting Water Mains.
- N. AWWA C110 Ductile-Iron and Gray-Iron Fittings
- O. AWWA C153 Ductile-Iron Compact Fittings

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's catalog cuts for pipe, fittings, joint couplings; Backflow preventers and assemblies, fire hydrants; water meters and accessories; valves; and valve boxes.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
 - 1. Notify OWNER'S REPRESENTATIVE not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without OWNER'S REPRESENTATIVE written permission.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company supplying water requirements.
- B. All work to be performed and materials to be used shall be in accordance with the Standard Specifications for Public Works Construction, latest edition and supplements.
- C. The Contractor shall have a copy of the Standard Specifications at the job site.
- D. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- E. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- F. NFPA Compliance: Comply with NFPA 24 for materials, installation, testing, flushing, and valve and hydrant supervision for fire service main piping for fire suppression.
- G. NSF Compliance:
 - 1. Comply with NSF 14 for plastic potable-water-service piping.
 - 2. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage: Do not store materials directly on the ground. Support the pipe uniformly during shipping and storage. Do not stack higher than 4 feet nor stack with weight on bells. Cover the pipe with plastic to protect it from sunlight. Keep inside of pipe and fittings free of dirt and debris. Avoid scratching the pipe surface.
- B. Take special care to avoid damage to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged.
- C. Prior to installation, each pipe length shall be carefully inspected for damage.
- D. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.
- E. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.
- F. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.
- G. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

PART 2 PRODUCTS

2.1 WATER PIPE

- A. PVC Pipe (NPS 1"-3"): ASTM D1785 Schedule 80.
 - 1. Fittings: ASTM D2467, PVC.
 - 2. Joints: ASTM D2855, solvent weld.
- B. PVC Pipe (NPS 4"-12"): AWWA C900 Class 235:
 - 1. Ductile Iron Mechanical Joint Fittings: AWWA C110 Ductile Iron and Gray-Iron Fittings or AWWA C153 Ductile Iron Compact Fittings
 - 2. Gaskets: AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 3. Joints: ASTM D3139 compression gasket ring.
- C. Pipe for potable water use shall be blue, or dark grey in color. Pipe for recycled or reclaimed water use shall be purple in color.
- D. Tracer Wire: #8 AWG Type UF (direct burial) stranded single conductor cable with high density polyethylene (HDPE) or high molecular weight polyethylene (HMWPE) insulation. The insulation shall be black in color. The tracer wire shall be taped to top of pipe every ten feet.

- E. Detectable Warning Tape: Install detectable warning tape during the installation of proposed utilities on contract drawings. Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 5 mils (0.1mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep, colored as follows:
 - 1. Blue: Potable water and fire protection service systems.
 - a. Imprinted with "CAUTION BURIED WATER LINE BELOW" in large letters.
 - 2. Purple: Recycled/Reclaimed Water.
 - a. Imprinted with "CAUTION BURIED RECLAIMED WATER LINE BELOW" in large letters.

2.2 VALVES

- A. Valves: Manufacturer's name and pressure rating marked on valve body.
- B. Gate Valves 3 Inches and Over:
 - 1. AWWA C509, iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, flanged ends, control rod, post indicator, valve key, and extension box.

2.3 HYDRANTS

- A. Hydrants: Type as required by utility company supplying water and fire department having jurisdiction.
 - 1. Before procurement, verify approval has been issued by the fire department having jurisdiction.
- B. Finish: Primer and two coats of enamel in color required by utility company and fire department having jurisdiction.

2.4 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Project Geotechnical Report, and contract drawings.
- B. Cover: As specified in Project Geotechnical Report, and contract drawings.

2.5 ACCESSORIES

- A. Concrete for Thrust Restraints: As specified in the water purveyor supplying water standard specifications, or Standard Specifications for Public Works Construction; latest edition.
- B. Meter: as required by water company.

2.6 CORROSION-PROTECTION ENCASUREMENT FOR PIPING

- A. Polyethylene Encasement for Underground Ductile-Iron Pipe and Fittings: Polyethylene encasement of eight mils thickness shall conform to AWWA C105. Joint tape shall be self sticking PVC or polyethylene, eight mils thick.
- B. Fusion-Bonded Epoxy Coatings for Ductile-Iron and Gray-Iron Fittings: Epoxy coating shall conform to AWWA C116.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to beginning work, verify that building service connection and municipal and site water main size, location, and invert are as indicated.
- B. Examine trench bottom to ensure that it is accurately graded to provide uniform bearing and to support pipe.

3.2 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.3 TRENCHING

- A. See the contract drawings for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide applicable square feet thrust restraint bearing on subsoil per contract drawing details and references.
- D. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil, size as indicated.
- E. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.4 INSTALLATION - PIPE

- A. Project site water lines shall terminate approximately five feet from buildings, unless otherwise indicated on Drawings. Install temporary cap or plug terminals for future connection to building.
- B. Bury piping with depth of cover over top at least 36 inches, unless otherwise indicated.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
- D. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports for all lines NPS 3 or greater.
- E. Water Main Connection: Arrange and pay for tap in the water main, water meter, and all associated fees from the water purveyor.
- F. Maintain separation of water main from sewer piping in accordance with applicable codes, jurisdictional requirements and the following:
 - 1. Lay water mains over sanitary sewer lines to provide vertical separation a minimum of 3 feet.
 - a. If 3 feet minimum separation cannot be met:
 - 1) Install water line with all joints located at least 5 feet from each side of the sewer pipe.
 - 2) Encase sewer in 6 inches of concrete around pipe extended to 5 feet of either side of water pipe.
- G. Install pipe to indicated elevation to within tolerance of 1/2 inches.
- H. All pipe shall be laid true to line and grade as shown on the contract drawings.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Install tracer wire on top of pipe per contract drawing trenching detail. Tape tracer wire to pipe every 10 feet.
 - 1. Wire shall be continuous strand. Crimpable copper butt splice kits are permitted in valve cans only. At valve cans, wire shall be routed up the outside of the valve riser, into the valve can at the top, 12-inch looped, and back down the outside of the valve riser.
 - 2. Wire shall terminate at surface in an in ground traffic rated access box labeled "Water".

3.5 INSTALLATION - VALVES, HYDRANTS, BACKFLOW PREVENTERS

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with proposed finished grade.

- C. Post Indicator Valve installation shall comply with NFPA 24. Include tamperproof electrical supervisory switch connected to fire alarm control panel.
- D. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway.
- E. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 211100.
- F. Paint hydrants as required by the local fire authority or as indicated.

3.6 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves and sand strainer.

3.7 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Potable Water:
 - 1. Perform hydrostatic testing on private and public water piping as required by the local water purveyor supplying water.
 - 2. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.
- C. Fire Water:
 - 1. Perform flushing and hydrostatic testing in accordance with the applicable version of NFPA 24.
- D. Perform Tracer Wire Continuity Tests.
- E. Prepare reports of all testing activities.

3.8 CLEANING

- A. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
- B. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651.

END OF SECTION 331416

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SECTION 333113 - SITE SANITARY SEWERAGE GRAVITY PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to existing onsite sewer system.

1.2 RELATED REQUIREMENTS

- A. Project Geotechnical Report.

1.3 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.4 REFERENCE STANDARDS

- A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

1.5 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to the requirements indicated:
 - 1. Notify OWNER'S REPRESENTATIVE not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without OWNER'S REPRESENTATIVE written permission.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and other sewer components as indicated.
- C. Field Quality Control Submittals: Document results of field quality control testing.
- D. Project Record Documents:
 - 1. Record location of pipe runs, connections, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.1 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Plastic Pipe: ASTM D3034, SDR 35, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter as indicated, bell and spigot style rubber gasket joints.
- C. 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.

2.2 PIPE ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, woven [Mirafi] ;[140N]manufactured by[Mirafi].
- B. Detectable Warning Tape: Install detectable warning tape during the installation of proposed utilities on contract drawings. Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 5 mils (0.1mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep, colored as follows:
 1. Green: Sewer drainage systems.
 2. Imprinted with "CAUTION BURIED SEWER LINE BELOW" in large letters.

2.3 MANHOLE

- A. Lid and Frame: Cast iron construction.

2.4 BEDDING AND COVER MATERIALS

- A. Bedding Material: As specified in Project Geotechnical Report, and contract drawings.
- B. Cover Material: As specified in Project Geotechnical Report, and contract drawings.

PART 3 EXECUTION

3.1 GENERAL

- A. Perform work in accordance with applicable code(s).

3.2 EXAMINATION

- A. Prior to beginning work, verify that building service connections, municipal and site storm main size, location, and invert are as indicated.

3.3 TRENCHING

- A. See Project Geotechnical Report for additional requirements.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavation for accurate placement of pipe to elevations indicated.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume.
- I. Remove excess excavated material and material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site.
- K. Provide temporary means and methods, as required, to remove all water from trenching. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.4 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

- D. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- E. Install continuous detectable warning tape 12 inches above top of pipe.

3.5 INSTALLATION - CLEANOUTS

- A. Form bottom of excavation clean and smooth to correct elevation.
- B. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- C. Establish elevations and pipe inverts for inlets and outlets as indicated.
- D. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.6 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 014000.
- B. Do not enclose, cover, or put into service before inspection and approval.
- C. Tests: Upon completion of this portion of the work, and prior to acceptance by the owner, perform all required tests and secure approvals from agencies having jurisdiction.
- D. Submit separate reports for each system inspection and test.
- E. Defects requiring correction include the following:
 - 1. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - 2. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - 3. Infiltration: Water leaking into piping.
 - 4. Exfiltration: Water leakage from or around piping.
 - 5. Leaks and loss in test pressure constitute defects that must be repaired.
- F. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- G. Reinspect and repeat procedure until results are satisfactory.
- H. Gravity-Flow Sewer Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - 1. Option: Test according to requirements set forth in ASTM F 1417.

3.7 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333113

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SECTION 334211 - STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Gravity-flow, nonpressure site stormwater drainage piping.
- B. Stormwater pipe accessories.

1.2 RELATED REQUIREMENTS

- A. Project Geotechnical Report.

1.3 REFERENCE STANDARDS

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2023.
- B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2021.
- C. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- D. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- E. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- F. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- G. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2021.
- H. Standard Specifications for Public Works Construction (Greenbook); current edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories, and other drain components as indicated.
- C. Field Quality Control Submittals: Document results of field quality control testing.

D. Project Record Documents:

1. Record location of pipe runs, connections, and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 PROJECT CONDITIONS

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

1. Notify OWNER'S REPRESENTATIVE not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without OWNER'S REPRESENTATIVE written permission.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPE MATERIALS

- A. Plastic Pipe: ASTM D3034, Type PSM, SDR 35 Poly Vinyl Chloride (PVC) material; inside nominal diameter of 4-12 inches, bell and spigot style gasketed sealed joint ends.
- B. Plastic Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner; inside nominal diameter of 18-60 inch, meeting the requirements of AASHTO M 252, Type S, for diameters between 3 inches and 10 inches and AASHTO M 294, Type S, for diameters between 18 inches and 60 inches, water-tight, bell and spigot joints with rubber gaskets, with pipe and fittings manufactured from virgin PE compounds with cell classification 3254420C.
- C. Cast in Place Concrete: Greenbook Section 201-1.

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.
- B. Geotextile Fabric: Non-biodegradable, woven [Mirafi] ;[140N]manufactured by[Mirafi].
- C. Detectable Warning Tape: Install detectable warning tape during the installation of proposed utilities on contract drawings. Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 5 mils (0.1mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep, colored as follows:
1. Green: Storm drainage systems.

2. Imprinted with "CAUTION BURIED STORM DRAIN LINE BELOW" in large letters.

2.3 BEDDING AND COVER MATERIALS

- A. Bedding Material: As specified in Project Geotechnical Report, and contract drawings.
- B. Cover Material: As specified in Project Geotechnical Report, and contract drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to beginning work, verify that building service connection and municipal and site utility water main size, location, and invert are as indicated.

3.2 TRENCHING

- A. See Project Geotechnical Report for additional requirements.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavation for accurate placement of pipe to elevations indicated.
- G. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- H. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume.
- I. Remove excess excavated material and material that is unsuitable for re-use from site.
- J. Stockpile excavated material to be re-used in area designated on site.
- K. Provide temporary means and methods, as required, to remove all water from trenching. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- L. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.3 INSTALLATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.
- E. Install continuous detectable warning tape 12 inches above top of pipe.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 014000 - Quality Requirements.
- B. Do not enclose, cover, or put into service before inspection and approval.
- C. Tests: Upon completion of this portion of the work, and prior to acceptance by the owner, perform all required tests and secure approvals from agencies having jurisdiction.
 - 1. Submit separate reports for each system inspection and test.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5% of internal piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leaking into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - f. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
 - 5. PVC Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test according to requirements set forth in ASTM F 1417.

3.5 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 334211