



DLR Group

Architecture

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Interiors

Vose ES Addition Beaverton School District Beaverton, Oregon

Project Manual 100% CD Volume 1 of 2, Divisions 01-12 DLR Group Project No. 74-21102-00

February 26, 2021

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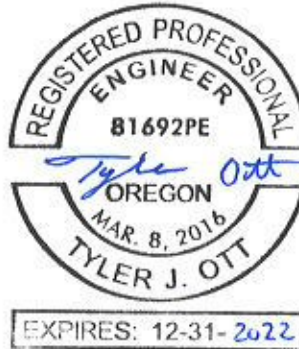
Project Manual

**Vose ES Addition
Beaverton School District
Beaverton, Oregon**

DLR Group Project No. 74-21102-00
Combined Contract

February 26, 2021

100% CD



DLR Group Architecture & Engineering inc., an Oregon corporation
Architecture Engineering Planning Interiors
110 SW Yamhill Street, Suite 105, Portland, OR 97204
tel 503/274-2675 fax 503/274-0313

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| | |
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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Purchase contracts.
8. Owner-furnished products.
9. Contractor-furnished, Owner-installed products.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and Drawing conventions.
14. Miscellaneous provisions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: Beaverton Prototype Elementary School.

1. Project Location: 11350 SW Denney Rd. Beaverton, OR 97008.

- B. Owner: Beaverton School District
Owner's Representative: Eric Bolken
Construction Project Manager
Facilities Development Department

SUMMARY

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16550 SW Merlo Road
Beaverton, OR 97003
(503) 356-4364

- C. Architect: DLR Group
- D. Web-Based Project Software: Project software administered by Owner will be used for purposes of managing communication and documents during the construction stage.
 - 1. See Beaverton School District standards for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 - 1. 4,650 SF Renovation and 5,200 SF Addition to existing elementary school to be constructed of Type IIB fully sprinklered construction and other Work indicated in the Contract Documents.
- B. Type of Contract:
 - 1. Project will be constructed under a single prime contract (per AIA documents A101-2007 and A201-2007).

1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.6 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
 - 1. As noted in Owner Furnished Material and Equipment Schedule in drawing set.

1.7 ACCESS TO SITE

- A. General: Contractor shall have access to the Project site during the construction period according to AIA201 3.13.

SUMMARY

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1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- C. Restricted Substances: Use of tobacco products and other controlled substances on Project site is not permitted.
- D. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- E. Employee Screening: Comply with Owner's requirements for screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.
 - 2. Badging to be provided by contractor.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description of Alternates.
- B. Procedures for pricing Alternates.

1.2 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.3 SCHEDULE OF ALTERNATES

- A. Alternate No. 1, Restrooms and Sinks in G102 and G104
 - 1. Base Bid: Provide casework in rooms G102 and G104 without plumbing and associated casework and fixtures. Provide wide hallway at G100 with wall, floor, and ceiling finishes to match rest of G100. See Drawings.
 - 2. Additive Alternate: Provide sink and associated plumbing, casework, and additional countertop length in rooms G102 and G104 per drawings. Provide restrooms G101 and G103 per drawings.
- B. Alternate No. 2, Sinks in G106, G107, and G108
 - 1. Base Bid: Provide casework in rooms G106, G107, and G108 without plumbing or associated casework and fixtures. See Drawings.
 - 2. Additive Alternate: Provide sink and associated plumbing, casework, and additional countertop length in rooms G106, G107 and G108 per drawings.
- C. Alternate No. 3, Operable Wall
 - 1. Base Bid: Provide typical S6b wall with two outlets on library side between rooms G110 and G114.
 - 2. Additive Alternate: Provide operable wall with marker board on library side between rooms G110 and G114 per drawings.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012300

ALTERNATES

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor that are not required in order to meet other Project requirements but may offer advantage to Contractor.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Refer to AIA Document A201 in the Supplementary Conditions for consideration of requests received after Contract award. Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

- b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SUBSTITUTION PROCEDURES

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (AIA 201), including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710 and eBuilder.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

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

1.5 CHANGE ORDER PROCEDURES

- A. A Change Order is a written instrument prepared by the Architect, Owner or Contractor and signed by the Owner, Contractor and (at Owner's election) Architect stating their agreement upon all of the following:
 1. The change in the Work;
 2. The amount of the adjustment, if any, in the Contract Sum; and
 3. The extent of the adjustment, if any, in the Contract Time.
- B. Methods used in determining adjustments to the Contract Sum may include those listed in Section 7.3.3.
- C. Agreement on any Amendment shall constitute a final settlement of all matters relating to the change in the Work that is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments to the Contract Sum, the construction schedule, and the Contract Time.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. A Construction Change Directive is a written order signed by the Owner (and at Owner's election, prepared and/or signed by Architect), directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.
- B. A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.
- C. Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved. As soon as possible, but no longer than seven days of receipt, the Contractor shall advise the Owner and the Architect of the Contractor's agreement or disagreement with the cost or the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time. If the Contractor does not timely disagree with the adjustments, the Construction Change Directive will be deemed an agreed "Change Order". The Contractor's notice shall reasonably specify the reasons for its disagreement and the amount or other terms that it proposes. Without such timely written notice, the Contractor shall conclusively be deemed to have accepted the Owner's adjustment. The Contractor's disagreement shall not relieve the Contractor its obligation to comply promptly with any written notice issued by the Owner or the Architect. The adjustment shall then be determined by the Owner on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, in strict accordance with this Paragraph and other applicable provisions of the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

- a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 5. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
 6. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 7. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

PAYMENT PROCEDURES

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2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- D. Transmittal: Submit signed and notarized original copies of each Application for Payment to Architect through Owner's web-based program (eBuilder).
- E. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Products list (preliminary if not final).
 5. Sustainable design action plans, including preliminary project materials cost data.
 6. Schedule of unit prices.
 7. Submittal schedule (preliminary if not final).
 8. List of Contractor's staff assignments.
 9. List of Contractor's principal consultants.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 12. Initial progress report.
 13. Report of preconstruction conference.
- F. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 3. Contractor shall provide all requirements of documents AIA 201 Section 9.10.2.
- G. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. All listed items in AIA Document A201 Section 9.10.2.

VOSE ES ADDITION
BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
100% CD

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

PAYMENT PROCEDURES

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 - 3. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

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

1. Post copies of list in project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

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

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

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

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

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

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

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:

- a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version, operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 4. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 5. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

- a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in BIM.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
6. Allow up to 14 working days for review by owner and architect.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
 2. RFIs will be submitted through owner provided web-based program (eBuilder).

- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project software. Software log with not less than the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
 - 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
 - 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 - 3. Digital Drawing Software Program: Contract Drawings are available in BIM (Revit).
 - 4. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.
 - a. Sub-contractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106.
- B. Web-Based Project Software: Use Owner's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
- C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.
 - 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect and Owner's Commissioning Authority of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

- a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

- a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.

- 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
- a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. AIA Document A201, Section 3.10

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- C. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 1. Working electronic copy of schedule file, where indicated.
 2. PDF file.
- B. Startup construction schedule.
 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at monthly intervals.
- F. Material Location Reports: Submit at monthly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.
- H. Unusual Event Reports: Submit at time of unusual event.
- I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 1. Review software limitations and content and format for reports.
 2. Verify availability of qualified personnel needed to develop and update schedule.
 3. Discuss constraints, including phasing work stages area separations and interim milestones.

4. Review delivery dates for Owner-furnished products.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the submittal schedule, progress reports, payment requests, and other required schedules and reports.
 1. Secure time commitments for performing critical elements of the Work from entities involved.
 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 1. Use Scheduling component of Project website software specified in Section 013100 "Project Management and Coordination," or other approved software available to owner and architect for current Windows operating system.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
 5. Commissioning Time: Include no fewer than 15 days for commissioning.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Uninterruptible services.
 - c. Use-of-premises restrictions.
 - d. Provisions for future construction.
 - e. Seasonal variations.
 - f. Environmental control.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.

- G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven 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. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.

- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. Construction Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

VOSE ES ADDITION
BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
100% CD

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. AIA Document A201, Section 3.12

1.2 SUMMARY

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

1.3 DEFINITIONS

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

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

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.

9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Location(s) where product is to be installed, as appropriate.
 13. Other necessary identification.
 14. Remarks.
 15. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 1. Initial Review: Allow 14 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 14 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 14 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 14 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect and Construction Manager.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

SUBMITTAL PROCEDURES

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2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

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

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
 - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
 - 2. Submittals by Web-Based Project Software: Architect will indicate, on Project software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- D. Architect will return without review submittals received from sources other than Contractor.
- E. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

SUBMITTAL PROCEDURES

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
 - D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
 - E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
 - F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
 - G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
 - H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
 - I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
 - J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.
- 1.4 DELEGATED-DESIGN SERVICES
- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

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

1.5 CONFLICTING REQUIREMENTS

- A. **Conflicting Standards and Other Requirements:** If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

- A. **Shop Drawings:** For integrated exterior mockups.
 1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
 2. Indicate manufacturer and model number of individual components.
 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. **Delegated-Design Services Submittal:** In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

- A. **Contractor's Quality-Control Plan:** For quality-assurance and quality-control activities and responsibilities.
- B. **Qualification Data:** For Contractor's quality-control personnel.
- C. **Contractor's Statement of Responsibility:** When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Entity responsible for performing tests and inspections.
 3. Description of test and inspection.
 4. Identification of applicable standards.
 5. Identification of test and inspection methods.
 6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.
- 1.8 CONTRACTOR'S QUALITY-CONTROL PLAN
- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections will be conducted by Owner.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products which are similar in material, design, and extent to those indicated for this Project.

- F. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups of size indicated.
 - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
 - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.

4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
 5. Demonstrate the proposed range of aesthetic effects and workmanship.
 6. Obtain Architect's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1.11 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 2. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
 3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
 1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, that includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and re-inspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

QUALITY REQUIREMENTS

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1. Submit log at Project closeout as part of Project Record Documents.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if

REFERENCES

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bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

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

1.4 ABBREVIATIONS AND ACRONYMS

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

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.

32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).

75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; <http://www.iec.ch>.
105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).

115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.

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

REFERENCES

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201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 203. WI - Woodwork Institute; www.wicnet.org.
 204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
 205. WWPA - Western Wood Products Association; www.wwpa.org.
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and

regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, testing agencies, and authorities having jurisdiction.
- A. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- B. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- C. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

TEMPORARY FACILITIES AND CONTROLS

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- C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel 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 and bottom rails. Provide concrete bases for supporting posts.
- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

TEMPORARY FACILITIES AND CONTROLS

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1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 3. Drinking water and private toilet.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 5. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- C. Field Office, Owner: Prefabricated or mobile units of minimum size at least 10'x32'. Furnish and equip offices as follows:
1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 2. Drinking water and private toilet.
 3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 4. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction. and clean HVAC system as required in Section 017700 "Closeout Procedures."
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
 - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction as needed.
- D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use as available.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- F. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Install electric power service underground, unless overhead service must be used.
 - 2. Where power distribution wiring is required by circumstances to be overhead, arrange it to rise vertically where least exposed to damage.
 - 3. Connect temporary service to new electrical transformer as directed by electric company officials.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.
- J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail and internet access, in common-use facilities.
 - 1. The Contractor shall provide an e-mail account for the duration of the project, commencing from the time job site offices are established to post final completion. All communication to be via email or the Owner's eBuilder site. Faxes will not be accepted.
 - 2. Provide the following infrastructure for the computer to be used by the Owner, Architect/Engineers.
 - a. An RJ45 wall jack on the near location when the computer is to be set, connected to:
 - b. A network device that has the capability, such as a router, which has the capability to issue a DHCP address to the computer that we will be using at that site.
 - c. The network device (router) should also have the ability to connect the computer that we will be using at that site to the internet.
 - d. An RJ 45 cable to connect from the RJ45 wall jack to the computer that we will be using at that site.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access. Contractor's temporary facility locations shall be sited to provide the least disturbance possible to neighboring properties – Owner reserves the right to direct the location of temporary facilities like job-site trailers or temporary toilets.
2. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
4. Combustible structures should not be within 30 feet of trees or power poles.

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

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

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

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31.
3. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion.

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

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

E. Parking: Provide temporary parking areas for construction personnel.

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

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 3. Maintain and touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

- D. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
 - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees from damage.

1.2 RELATED SECTIONS

- A. Section 328000 Irrigation.
- B. Section 329000 Planting.

1.3 REFERENCE STANDARDS

- A. ANSI A300 - Tree Care Operations Standards

1.4 DEFINITIONS

- A. Designated Trees: Existing Trees to Remain as indicated on Drawings.
- B. Critical Root Zone (CRZ):
 - 1. CRZ for trees 4 inches in caliper or smaller shall be an area with a radius at least 5 feet from the trunk.
 - 2. CRZ for trees over 4 inches in caliper shall be the greater area of the below options:
 - a. An area 5 feet beyond the existing tree canopy.
- C. Zone of Protection: The CRZ and as indicated on Drawings.

1.5 POSTING

- A. When directed, post Designated Trees with Notice sign provided by Owner's Representative. Attach sign to tree with twine or staples, no nails. Maintain and protect the Notice sign until completion of construction. Obtain approval of Owner's Representative prior to removal of sign.

1.6 NOTICE

- A. Notify all workers, including subcontractors, of the requirements to protect Designated Trees using Notice provided.

1.7 PROTECTIVE FENCING

- A. Install protective fencing around Designated Trees, where shown on Drawings, prior to commencement of any work. Fencing to be a minimum 6 foot chain link, with fence posts securely anchored. Maintain during construction. Adjustments to fence locations are to be approved by the Owner's Representative prior to performing any work within the Zone of Protection.
- B. No construction activities are permitted within the protective fencing without prior approval of the Owner's Representative.

1.8 TRENCHING AND EXCAVATION

- A. All trenching and excavation within the Zone of Protection is to be performed with the use of an air spade or by hand. Obtain Owner's Representative approval of trenching and excavation locations and methods prior to performing any work.

1.9 ROOT PRUNING

- A. Prune roots encountered during construction with an approved root-pruning device. Make clean, vertical cuts. Do not leave split or frayed ends. Obtain Owner's Representative approval prior to cutting roots larger than 1 1/2 inches in diameter. Backfill exposed roots with specified Planting Soil as soon as practical.

1.10 TREE CANOPY PRUNING

- A. Prune canopies of Designated Trees impacted by construction only upon approval of Owner's Representative. All canopy pruning must be performed by a certified arborist.

1.11 MULCH

- A. Provide four (4) inch deep bark mulch within zone of protection as directed, see Section 329000 - Planting.

1.12 WATERING

- A. Water trees if required by Owner's Representative. Watering will be required if it is judged that root removal is necessary for construction and threatens the survival of the tree. Use a slow drip or soaker hose to provide one-inch water per week until completion of construction.

1.13 PROHIBITED ACTIVITIES

- A. Cutting of roots larger than 1 1/2 inch diameter or larger without approval of Owner's Representative.
- B. Damaging tree bark or branches.
- C. Removal of protective fencing or notice posted on trees prior to approval of Owner's Representative.
- D. Activities prohibited within the Zone of Protection (without prior approval) are, but not limited to: construction, operation of machinery, storage of materials, paving, grading, cutting, filling, travel within, dumping, disposal of liquids, and parking of vehicles or equipment.

1.14 DAMAGE

- A. Actual tree damage such as trunk scoring and broken limbs or damaged roots inside the Zone of Protection will be assessed according to the percentage of loss of tree value. Percentage of tree value will be determined by the Owner's Representative. Tree value will be determined from "Evaluation of Landscape Trees, Shrubs, and Other Landscape Plants" by International Society of Arboriculture.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 012300 "Alternates" for products selected under an alternate.
 - 2. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 3. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual

characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

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

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.

PRODUCT REQUIREMENTS

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2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weather-tight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:

PRODUCT REQUIREMENTS

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1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 2. Evidence that proposed product provides specified warranty.
 3. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 4. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

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BEAVERTON, OREGON

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26 FEBRUARY 2021
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PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

PRODUCT REQUIREMENTS

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Installation of the Work.
 - 3. Cutting and patching.
 - 4. Protection of installed construction.
 - 5. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary"
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

1.4 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit digital copy showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety
 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where

EXECUTION

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indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect.

3.3 CONSTRUCTION LAYOUT

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

- B. Engage a professional engineer experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb, and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall

coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

- a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls." Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.
- B. Reports: Submit monthly documentation to Owner with each Application for Payment prior to Substantial Completion substantiating that Waste Management Plan was maintained and that goals were achieved.
 - 1. Trash: Quantity by weight deposited in landfills. Include associated fees, transportation costs, container rentals, and taxes for total cost of disposal.

2. Salvaged Material: Quantity by weight or quantity with destination for each type of material salvaged for resale, recycling, or adaptive reuse. Include associated fees, transportation costs, container rentals, and taxes for total cost of disposal. Also, include reimbursements due to salvage resale.
3. Total Cost: Indicate total cost or savings for implementation of Waste Management Plan. This does not imply reimbursement by Owner.

1.5 QUALITY ASSURANCE

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

1.6 WASTE MANAGEMENT PLAN

- A. Waste Management Plan: Include the following information
 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING

- A. A. Use Source Separation Method or Co-mingling Method suitable to sorting and processing method of selected recycling center. Dispose non-recyclable trash separately into landfill.
 1. Source Separation Method: Recyclable materials separated from trash and sorted into bins or containers prior to transportation to recycling center.
 2. Co-Mingling Method: Recyclable materials separated from trash and placed in unsorted bins or container for sorting at recycling center.
- B. Materials suggested for recycling include:
 1. Packing materials including paper, cardboard, foam plastic, and sheeting.
 2. Recyclable plastics.
 3. Organic plant debris.
 4. Earth materials.
 5. Native stone and granular fill.
 6. Asphalt and paving.
 7. Wood.
 8. Glass.
 9. Metals.
 10. Gypsum products.
 11. Acoustical ceiling tile.
 12. Carpet.
 13. Equipment oil.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Contractor will be responsible for disposing of any equipment in the existing buildings not scheduled to be salvaged to the owner.

2. Contractor will be responsible for disposing of remaining school portable units if present.
 3. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 4. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Burying: Do not bury waste materials.
- D. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.
- E. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at final completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

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- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, damage or settlement surveys, property surveys, Closeout Submittal Log, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

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3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit final completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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1. Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit by uploading to web-based project software site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.

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- k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with Owner waste disposal.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
 - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

CLOSEOUT PROCEDURES

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect and Commissioning Authority and Beaverton School District will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's and Beaverton School District's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic keyword searchable PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. For each product, provide 1 pdf containing all Product Data and 1 pdf containing the Warranty. Place pdfs into files named according to CSI format
 3. Provide all documents on USB Drive.

1.6 REQUIREMENTS FOR OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manual: Unless otherwise indicated, organize single manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. The manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents to be uploaded to web-based project software site
 - a. Contact list
 - b. Certificate of Substantial Completion (AIA G704-2000)
 - c. Contractor's Statement of Warranty
 - d. Lead Free Certification Letter

- e. Asbestos Free Certification Letter
- f. Certificate of Occupancy
- g. Final Permit Inspection Approvals
- h. Product Data (including shop drawings, where applicable) and Warranties organized by CSI Format.

1.7 OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, sub-system, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, sub-system, and piece of equipment included in the manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

- a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- I. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.9 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 PRELIMINARY CLOSEOUT SUBMITTALS

- A. Submit to the owner the following for review:
 - 1. Revit model detailed to LOD 300.
 - 2. CAD files & X-refs (ie Landscape dwgs).
 - 3. Draft Operations and Maintenance Manual.

1.4 CLOSEOUT SUBMITTALS

- A. One (1) USB containing O&M Manual; Specs; Revit model; DWG files; pdfs of Record Drawings, Redline Drawings (scanned if necessary) and Permit Drawings (scanned)
- B. One (1) hard copy of Permit Drawing Set (original stamp, signature, & date)
- C. One (1) hard copy of Record Drawings + As – Built deferred submittals such as FA and FS
- D. One (1) hard copy Specifications book.

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- E. One (1) hard copy of the Irrigation Plan Color Coded
- F. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.5 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Annotated PDF electronic file with comment function enabled Via USB Drive.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled via USB Drive.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.6 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Note related Change Orders and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file via USB drive.

1.7 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- C. Format: Submit record Product Data as annotated PDF electronic file via USB Drive.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.8 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file via USB Drive.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.9 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

VOSE ES ADDITION
BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
100% CD

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

PROJECT RECORD DOCUMENTS

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module. Include Closed Captioning in video recordings.
 - 1. Identification: On each copy, provide an applied label with the following information:

- a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
2. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.
- D. In addition to general building training the subcontractors to provide trade specific training for Mechanical and Electrical systems. This training shall be conducted during commissioning of the building, 3 months after building competition and prior to 1 year warranty expiration.
 - 1. Each training sessions to last a maximum of 8 hours.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
 - 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.

- c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
- 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
- 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
- 6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
- 7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.

- c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
- d. Instructions for identifying parts and components.
- e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

VOSE ES ADDITION
BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
100% CD

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

DEMONSTRATION AND TRAINING

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SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Commissioning: Commissioning is a systematic process of ensuring and documenting that all building systems perform interactively according to the design intent and the owner's operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.
- B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
 - 2. Verify and document proper performance of equipment and systems.
 - 3. Verify that O&M documentation left on site is complete.
 - 4. Verify that the Owner's operating personnel are adequately trained.
- C. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

1.2 COORDINATION

- A. Commissioning Team: The members of the commissioning team consist of the Commissioning Authority (CxA), the owner's designated Project Manager (PM), the General Contractor (GC or Contractor), the architect and design engineers, the Plumbing Contractor (PC), the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.
- B. Management: The CxA is hired by the Owner directly. The CxA directs and coordinates the commissioning activities. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. The CxA's responsibilities are the same regardless of who hired the CxA.
- C. Scheduling: The CxA will work with the GC according to established protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the PM and GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling on an ongoing basis and make necessary notifications in a timely manner in order to expedite the commissioning process.

1.3 COMMISSIONING PROCESS

- A. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.
1. Commissioning during construction begins with a scoping meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members.
 2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
 3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.
 4. The CxA works with the Subs to develop startup plans and startup documentation formats, which may include providing the Subs with prefunctional checklists to be completed during the startup process.
 5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
 6. The Subs, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to approved plans, and may witness startup of selected systems and equipment.
 7. The CxA develops specific equipment and system functional testing procedures. The Subs review the procedures.
 8. The procedures are executed/witnessed and documented by the CxA, with the assistance of the Subs as necessary.
 9. Items of non-compliance in material, installation, programming, calibration, start-up or setup are corrected at the Sub's expense and the system retested.
 10. The CxA reviews O&M's for all commissioned systems for completeness.
 11. The CxA reviews and approves training plans/agenda for training provided by the Subs (for commissioned equipment), and verifies that training was completed as per the contract documents.
 12. The CxA issues a report of the commissioning process and results.
 13. The CxA performs a Near-Warranty End or Post Occupancy Review approximately 10 months into the 12 month warranty period.

1.4 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All of the following sections apply to the Work of this section.
1. Section 011000 "Summary" for Commissioning Authority responsibilities.
 2. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
 3. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.

GENERAL COMMISSIONING REQUIREMENTS

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4. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
5. Section 019119.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.
6. Section 210800 "Commissioning of Fire Suppression" for technical commissioning requirements for fire suppression.
7. Section 220800 "Commissioning of Plumbing" for technical commissioning requirements for plumbing.
8. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
9. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.
10. Section 270800 "Commissioning of Communications" for technical commissioning requirements for communications systems.

1.5 RESPONSIBILITIES

- A. The responsibilities of various parties in the commissioning process are provided in this section. It is noted that the services for the Commissioning Authority, Project Manager, Construction Manager, Architect, and HVAC mechanical and electrical designers/engineers are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.
- B. All Parties
 1. Follow the Commissioning Plan and Cx Specification requirements.
 2. Attend commissioning scoping meeting and additional meetings, as necessary.
- C. Architect (of the A/E)
 1. Attend the commissioning scoping meeting and selected commissioning team meetings.
 2. Perform normal submittal review, construction observation, as-built drawing preparation, O&M manual preparation, etc., as contracted.
 3. Provide any design narrative documentation requested by the CxA.
 4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
 5. Prepare and submit final as-built design intent documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
- D. Mechanical and Electrical Designers/Engineers (of the A/E)
 1. Perform normal submittal review, construction observation, O&M review, etc., as contracted.
 2. Review and respond to CxA review comments of construction documents and O&M manuals.

3. Coordinate with CxA for review of contractor submittals. Review and respond to CxA review comments. Incorporate CxA comments into response to contractors as appropriate.
4. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
5. Review draft functional/performance test procedures: respond with any comments.
6. Respond to issues in the Cx Log identified as awaiting action by Engineer.
7. Attend commissioning scoping meetings and other selected commissioning team meetings.
8. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

E. Commissioning Authority (CxA)

1. The CxA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CxA may assist with problem-solving, non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CxA.
2. Coordinate the commissioning work and, with the GC and PM, ensure that commissioning activities are being scheduled into the master schedule.
3. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
4. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
5. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
6. Review and comment on Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
7. Prepare and distribute pre-functional checklists and startup forms.
8. Perform site visits, as necessary, to observe component and system installations. Attend selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
9. Approve systems startup by reviewing start-up reports and by selected site observation.
10. Oversee sufficient functional testing of the control system and approve it to be used for TAB, before TAB is executed.
11. Review and comment on TAB report for commissioning related issues.
12. With necessary assistance and review from installing contractors, write the functional testing procedures for equipment and systems. This may include energy management

- control system trending, stand-alone data logger monitoring or manual functional testing. Submit to PM for review, and for approval if required.
13. Analyze any functional performance trend logs and monitoring data to verify performance.
 14. Witness selected startup/performance tests performed by installing contractors. Review and comment on test reports.
 15. Perform or witness functional test procedures on the commissioned equipment.
 16. Maintain a master deficiency and resolution log and a separate testing record. Provide the PM with written progress reports and test results with recommended actions.
 17. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
 18. Review Contractor's training plan for facility operating staff and building occupants. Verify Contractor's execution of plan.
 19. Review and comment on preliminary O&M manuals for commissioned systems.
 20. Provide a final commissioning report (as described in this section).
 21. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
 22. Return to the site at 10 months into the 12 month warranty period and do a brief review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Identify problems or concerns staff have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract.

F. Owner's Project Manager (PM)

1. Manage the contract of the A/E and of the GC.
2. Provide final approval for the completion of the commissioning work.
3. Provide construction documents for CxA review.
4. Review draft functional/performance test procedures; respond with any comments.
5. Respond to issues in the Cx Log identified as awaiting action by Owner.
6. Attend commissioning meetings.
7. Forward to CxA any start-up forms produced by vendors hired by owner.
8. Arrange for O&M staff to attend contractor training sessions; coordinate with GC and/or Subs to schedule.
9. Forward O&M manuals for any commissioned equipment provided by owner to CxA for review.
10. Ensure that any seasonal or deferred testing and any deficiency issues are addressed.

G. General Contractor (GC)

1. Designate one of their staff to be the General Contractor's Cx Coordinator, with whom the CxA coordinates all contractor Cx responsibilities.
2. Facilitate the coordination of the commissioning work by the CxA, and with the CxA ensure that commissioning activities are being scheduled into the master schedule.
3. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.

4. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
5. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
6. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
7. Schedule subcontractors to attend commissioning meetings when requested by CxA.
8. Deliver Pre-Functional checklists to subcontractors, collect completed forms and forward to CxA.
9. Forward completed contractor and vendor Start-up Forms for commissioned equipment to the CxA.
10. Submit RFI's generated by the CxA to the A/E.
11. Notify CxA when all Pre-Functional Checklists and Start-up Forms have been completed and systems are ready for Functional/performance testing.
12. Respond to all issues in the Cx Log identified as awaiting action by the GC.
13. Coordinate the training of owner personnel. Forward training plans and records to CxA for review.
14. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions and make available to the CxA, concurrent with the A/E review.
15. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

H. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment testing per agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CxA.
4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.

I. Subcontractors

1. Refer to division specific commissioning specification sections listed under 019113 part 1.4, "Related Work" for responsibilities specific to each subcontractor.

1.6 SYSTEMS TO BE COMMISSIONED

- A. The following equipment and associated systems will be commissioned in this project:

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1. Division 22: Plumbing Systems
 - a. Domestic Hot and Cold water systems
 - b. Hot water recirculation system
 2. Division 23: HVAC Systems
 - a. Air handling units
 - b. Exhaust fans
 - c. Terminal units
 - d. Heating water system
 - e. Airflow measuring stations
 - f. Control system for commissioned equipment
 3. Division 26: Electrical Systems
 - a. Lighting controls
 4. Division 28: Fire Detection and Alarm
 - a. Interface with life safety systems, fire protection systems, HVAC systems and elevators
- B. General references to equipment will refer to the above systems and their components.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup and initial checkout and required functional testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 23, except for equipment specific to and used by the TAB contractor in their commissioning responsibilities.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone data-logging equipment that may be used by the CxA.
- C. Data-logging equipment and software required to test equipment will be provided by the CxA for use by the CxA only, and shall not become the property of the Owner.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications*. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of $\pm 0.5^{\circ}\text{F}$ and a resolution of \pm

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0.2°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 MEETINGS

- A. Scoping Meeting: Within 60 days of commencement of construction, the CxA will schedule, plan and conduct a commissioning kickoff meeting with the entire commissioning team in attendance. Information gathered from this meeting will be used by the CxA to revise the Draft Commissioning Plan to its "final" version.
- B. Miscellaneous Meetings: CxA may attend regular construction meetings to keep informed of project progress & coordinate the commissioning activities. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs.

3.2 REPORTING

- A. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.
- B. A final summary report (about four to six pages, not including backup documentation) by the CxA will be provided to the PM, focusing on evaluating commissioning process issues and identifying areas where the process could be improved. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved issues, etc., will be compiled in appendices and provided with the summary report.

3.3 SUBMITTALS

- A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At minimum, the request will include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

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- B. The CxA may request additional design narrative from the A/E and Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.
- C. The Commissioning authority will review and approve submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications, which is the A/E's responsibility. The Commissioning authority will notify the GC, PM or A/E as requested, of items missing or areas that are not in conformance with Contract Documents and which requires resubmission.
- D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.06, Systems to be Commissioned.
- B. General: Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional testing of equipment or subsystems of the given system.
- C. Start-up and Initial Checkout Plan: The CxA shall assist the contractor in developing pre-functional checklists and a detailed start-up plan for all commissioned equipment. The primary role of the CxA in this process is ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed.
 - 1. The subcontractor responsible for the purchase of the equipment develops the full start-up plan. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.
 - 2. The full start-up plan could consist of something as simple as:
 - a. The CxA's, contractor's or manufacturer's prefunctional checklists.
 - b. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
 - c. The manufacturer's normally used field checkout sheets.

3. The subcontractor submits the full startup plan to the CxA for review and approval.
4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.
5. The full start-up procedures and the approval form may be provided to the PM for review and approval, depending on management protocol.

D. Execution of Prefunctional Checklists and Startup.

1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the PM, GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA shall verify compliance on at least 20% of equipment requiring formal start-up procedures.
3. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.

E. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for supervisors to fill out these forms unless they have personally witnessed or verified each item.

F. Deficiencies, Non-Conformance and Approval in Checklists and Startup.

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.
2. The CxA reviews the report and submits either a non-compliance report or an approval form to the Sub or PM. The CxA will work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the PM, GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in back-charges to the responsible party. Refer to Part 3.6 herein for details.

3.5 FUNCTIONAL TESTING

- A. This sub-section applies to all commissioning functional testing for all divisions.
- B. The general list of equipment to be commissioned is found in Section 01 91 00, Part 1.06.
- C. Objectives and Scope: The objective of functional testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional

testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required.

- D. Development of Test Procedures: Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor shall provide limited assistance to the CxA in developing the procedures (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CxA may submit the tests to the A/E for review, if requested.
- E. Test Methods
1. Functional testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone data-loggers.
 2. Simulated Conditions: Simulating conditions (not by an overwritten value) is allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 3. Overwritten Values: Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, is allowed, but will be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair dryer rather than overwriting the value or by altering the appropriate set point to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.
 4. Altering Set Points: Rather than overwriting sensor values, and when simulating conditions is difficult, altering set points to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout set point to be 2F above the current outside air temperature.
 5. Indirect Indicators: Relying on indirect indicators for responses or performance is allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
 6. Setup: Each function and test will be performed under conditions that simulate actual conditions as close as is practically possible. At completion of the test, the CxA will

return all affected building equipment and systems, due to temporary modifications, to their pre-test condition.

7. Sampling

- a. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy as approved by the owner representative. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference, alone, does not constitute a difference. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.
- b. A common sampling strategy is the “xx% Sampling—yy% Failure Rule”, defined by the following example.
 - 1) xx = the percent of the group of identical equipment to be included in each sample.
 - 2) yy = the percent of the sample that if failing, will require another sample to be tested.
 - 3) The example below describes a 20% Sampling—10% Failure Rule.
 - a) Randomly test at least 20% (xx) of each group of identical equipment. In no case test less than three units in each group. This 20%, or three, constitute the “first sample.”
 - b) If 10% (yy) of the units in the first sample fail the functional testings, test another 20% of the group (the second sample).
 - c) If 10% of the units in the second sample fail, test all remaining units in the whole group.
 - d) If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units, prior to continuing with functionally testing the remaining units.

F. Coordination and Scheduling.

1. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The Controls Contractor will provide written notification that they have completed all required prefunctional checklists, point-to-point verification, sensor calibration verification, programming verification checks, and that their system(s) are complete and ready for functional testing before testing will proceed. The CxA will schedule functional tests through the PM, GC and affected Subs. The CxA will develop, execute and document the functional testing of all equipment and systems.
2. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is complete and pre-functionally tested before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of

air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

- G. Test Equipment: Refer to Section 01 91 00, Part 2 for test equipment requirements.
- H. Problem Solving: The CxA will recommend solutions to problems found, however the burden of responsibility to solve, correct and retest problems is with the GC, Subs and A/E.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

- A. Documentation: The CxA will document the results of all functional tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the PM for review and approval and to the Subs for review.
- B. Non-Conformance
 - 1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the PM on the CxA's standard issues tracking form.
 - 2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases the deficiency and resolution will be documented on the procedure form.
 - 3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work, loosening acceptance criteria, or combining CxA functional testing with the contractor QA checkout procedures to satisfy scheduling or cost.
 - 4. A complete round of tests will be performed, with results and deficiencies reported to the Subs and the PM. The responsible Subs will then have an opportunity to correct the deficiencies and schedule re-testing. Re-testing of up to 10% of the total number of executed tests will be provided by the CxA at no additional charge. Costs of additional re-testing will be as described in the next section.
 - a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
 - 1) The CxA documents the deficiency and the Sub's response with intentions and they go on to another test or sequence. The Sub corrects the deficiency and notifies the CxA that the system is ready to be retested.
 - 2) The CxA reschedules the test and the test is repeated.
 - b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

- 1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the PM and to the Sub representative assumed to be responsible.
 - 2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
 - 3) The CxA documents the resolution process.
 - 4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved.
 5. Cost of Retesting.
 - a. The time for the CxA to execute any re-testing required because a specific *prefunctional* checklist or start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, may be back-charged to the GC, who may choose to recover costs from the party responsible for executing the faulty prefunctional check.
 - b. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CxA and PM will direct the retesting of up to 10% of the total executed tests once at no "charge" to the GC for their time. However, the CxA's time for a second test will be charged to the GC, who may choose to recover costs from the responsible Sub.
 - c. Refer to the sampling section of Section 01 91 00, Part 3.05 for requirements for testing and retesting identical equipment.
 6. The Contractor shall respond in writing to the CxA and PM the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
 7. Any required re-testing shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.
- C. Approval: The CxA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CxA and by the CM, if necessary. The CxA recommends acceptance of each test to the CM using a standard form.

3.7 OPERATION AND MAINTENANCE MANUALS AND FINAL REPORT

A. Standard O&M Manuals.

1. The specific content and format requirements for the standard O&M manuals are detailed in Division 01, with specific section requirements in Divisions 22, 23 & 26 for commissioned equipment.
2. CxA Review and Approval: Prior to substantial completion, the CxA will review the O&M manuals, documentation and redline as-builds *for systems that were commissioned*

to verify compliance with the *Specifications*. The CxA will communicate deficiencies in the manuals to the PM or A/E, as requested. The CxA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Final Commissioning Report

1. The final commissioning report will include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items will be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. will also be listed. Each non-compliance issue will be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment will include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.
2. Other documentation will be retained by the CxA.

3.8 TRAINING OF OWNER PERSONNEL

- A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed. NWESI's scope does not include any training review.

3.9 DEFERRED TESTING

- A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted as soon as possible. Services of necessary parties will be negotiated.

3.10 WRITTEN WORK PRODUCTS

- A. The commissioning process generates a number of written work products described in various parts of the *Specifications*. The *Commissioning Plan* lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them.

B. In summary, the written products are:

| Item no. | Product | Developed by |
|------------|--|-----------------------------|
| 01 9100-1 | Equipment documentation submittals | Subs |
| 01 9100-2 | Sequence clarifications | Subs and A/E as needed |
| 01 9100-3 | Pre-functional checklists | CxA |
| 01 9100-4 | Start-up and initial checkout plan | Subs w/ assistance from CxA |
| 01 9100-5 | Pre-functional checklists filled out | Subs |
| 01 9100-6 | Start-up and initial checkout forms filled out | Subs |
| 01 9100-7 | Final TAB report | TAB |
| 01 9100-8 | Issues log (deficiencies) | CxA |
| 01 9100-9 | Functional test forms | CxA |
| 01 9100-10 | Filled out functional tests | CxA |
| 01 9100-11 | Training plans and records | Subs |
| 01 9100-12 | O&M manuals | Subs |
| 01 9100-13 | Final Commissioning Report | CxA |

END OF SECTION 019113

The Commissioning Process

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Cognizant TC: 9.1, Large Building Air-Conditioning Systems
SPLS Liaison: Matt R. Hargan

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NOTE

When addenda, interpretations, or errata to this guideline have been approved, they can be downloaded free of charge from the ASHRAE Web site at <http://www.ashrae.org>.

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FOREWORD

The Commissioning Process is a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.

The Commissioning Process assumes that owners, programmers, designers, contractors, and operations and maintenance entities are fully accountable for the quality of their work. The Commissioning Team uses methods and tools to verify that the project is achieving the Owner's Project Requirements throughout the delivery of the project. For example, the contractor is responsible for fully constructing, testing, and ensuring that its employees' work has provided the level of quality expected. The Commissioning Authority then randomly samples the contractor's work to verify that it is achieving the Owner's Project Requirements. If systemic issues are identified, then the contractor is expected to recheck all of his/her work and correct any deficiencies. This quality-oriented process is different than when the Commissioning Authority does 100% checking or non-quality-based sampling. Guideline 0 has been developed to present an approach based on these assumptions.

The Commissioning Process begins at project inception (during the Pre-Design Phase) and continues for the life of the facility (through the Occupancy and Operations Phase). Because this Guideline details a process, it can be applied to both new and renovation projects. The Commissioning Process includes specific tasks to be conducted during each phase in order to verify that design, construction, and training meet the Owner's Project Requirements. This Guideline describes the overall Commissioning Process in order to provide a uniform, integrated, and consistent approach for delivering and operating facilities that meet an owner's ongoing requirements.

The Commissioning Process is a quality-based method that is adopted by an Owner to achieve successful construction projects. It is not an additional layer of construction or project management. In fact, its purpose is to reduce the cost of delivering construction projects and increase value to owners, occupants, and users. This Guideline has been developed

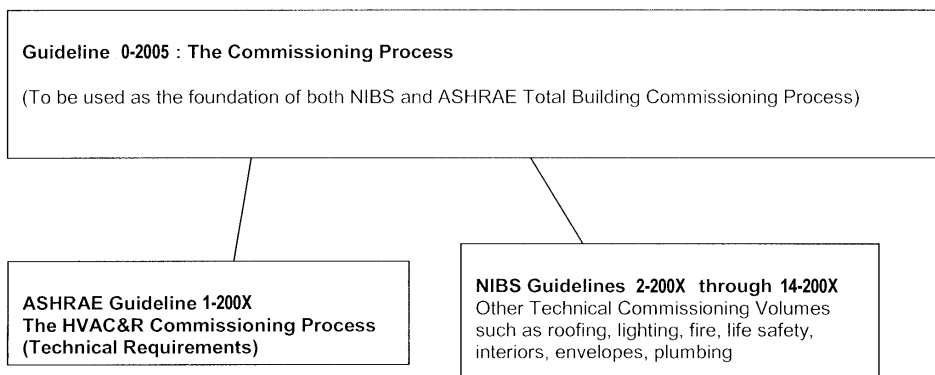
to assist those who are adopting or plan to adopt a better quality-based and cost-effective process.

Development of guidelines for the Commissioning Process began formally in 1982 when the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) formed a committee to document best practices to achieve facilities that performed according to the owner's project requirements. ASHRAE published its original commissioning guideline in 1989 and an updated version in 1996. The Commissioning Process detailed in these guidelines is the result of experience on projects requiring that systems and assemblies worked from the first day the project was turned over to the owner. This Commissioning Process is further based upon experience with projects that met the requirements of owners, occupants, users of processes, and facility operating-maintenance-service organizations at a high level of satisfaction and that reduced the cost to deliver the project.

Guideline 0 is an integral part of the National Institute of Building Sciences (NIBS) total building commissioning guideline series. The relationship of this guideline to other technical commissioning guidelines is shown below.

Guideline 0 presents details on the Commissioning Process without focusing upon specific systems or assemblies. Supplementary technical guidelines are being developed to provide specific and detailed information on how to implement the Commissioning Process for each major building/facility system or assembly. For example, this Guideline details what is required for a high-quality and effective Systems Manual and how and when it is developed, whereas a technical guideline details what specific information for a given system or assembly must be included in the Systems Manual.

The use of a common content organization and the focus upon specific information achieve a closely coordinated set of documents that can be used together or in any combination to accommodate varying owner requirements. This Commissioning Process guideline allows the technical commissioning guidelines to avoid repeating information on the commissioning process, making them more concise and focused relative to their technical requirements.



The fundamental objectives of the Commissioning Process are to:

- (a) *Clearly document Owner's Project Requirements;*
- (b) *Provide documentation and tools to improve the quality of deliverables;*
- (c) *Verify and document that systems and assemblies perform according to the Owner's Project Requirements;*
- (d) *Verify that adequate and accurate system and assembly documentation is provided to the owner;*
- (e) *Verify that operation and maintenance personnel and occupants are properly trained;*
- (f) *Provide a uniform and effective process for delivery of construction projects;*
- (g) *Deliver buildings and construction projects that meet the owner's needs, at the time of completion;*
- (h) *Utilize quality-based sampling techniques to detect systemic problems, as such sampling provides high value, efficient verification, accurate results, and reduced project costs; and*
- (i) *Verify proper coordination among systems and assemblies, and among all contractors, subcontractors, vendors, and manufacturers of furnished equipment and assemblies.*

Due to the integration and interdependency of facility systems, a performance deficiency in one system can result in less than optimal performance by other systems. Implementing the Commissioning Process is intended to reduce the project capital cost through the first year of operation and also reduce the life-cycle cost of the facility. Using this integrated process results in a fully functional, fine-tuned facility, with complete documentation of its systems and assemblies and trained operating and maintenance personnel.

Emphasis is placed on documentation of the Owner's Project Requirements at the inception of the project and the proper transfer of this information from one party to the next. Owners adopt the Commissioning Process to achieve their stated objectives and criteria—starting with the inception of a project instead of after a facility is occupied.

While circumstances may require owners to adopt the Commissioning Process during the Design or Construction Phase of a project, such later implementation must capture the information that would have been developed had the Commissioning Process begun at project inception. Beginning the Commissioning Process at project inception will achieve the maximum benefits.

Annexes to this document have been included to assist in further understanding the Commissioning Process and to aid in the development of the technical guidelines. The Annexes are based on specific project experience, with details on what is current best practice. Annexes illustrate varying applications of the Commissioning Process for all projects. Therefore, Annexes should be viewed as examples of how to develop documents and to define Owner's Project Requirements, Basis of Design, Commissioning Plan, benefits and roles in the Commissioning Process, verification, testing requirements, documentation, and training.

The Commissioning Process has been structured to coincide with the phases of a generic project with Pre-Design, Design, Construction, and Occupancy and Operations phases.

This guideline describes the Commissioning Process; the responsibilities of Commissioning Team participants; the role of the Commissioning Authority; and a model framework for developing a Commissioning Plan, specifications, and reports. This guideline also describes the general requirements for a training program for continued successful system and assembly performance. Documentation necessary to meet the guideline requirements is also described.

1. PURPOSE

1.1 The purpose of this guideline is to describe the Commissioning Process capable of verifying that a facility and its systems meet the Owner's Project Requirements.

2. SCOPE

2.1 The procedures, methods, and documentation requirements in this guideline describe each phase of the project delivery and the associated Commissioning Processes from pre-design through occupancy and operation, without regard to specific elements, assemblies, or systems, and provide the following:

- (a) overview of Commissioning Process activities,
- (b) description of each phase's processes,
- (c) requirements for acceptance of each phase,
- (d) requirements for documentation of each phase, and
- (e) requirements for training of operation and maintenance personnel.

2.2 These Commissioning Process guideline procedures include the Total Building Commissioning Process (TBCxP) as defined by National Institute of Building Sciences (NIBS) in its *Commissioning Process Guideline 0*.

3. UTILIZATION

3.1 The application of this guideline will depend upon the Owner's Project Requirements and how the project will be designed, built, and operated. The process described in this guideline is written for a generic project and must be adapted to each project.

3.2 This guideline describes the Commissioning Process, and is supplemented by companion technical guidelines. A technical guideline describes the specific details to properly implement the Commissioning Process relative to a specific facility system or assembly. Annex A in this guideline provides the required format for developing technical guidelines for the Commissioning Process.

4. DEFINITIONS

Acceptance: A formal action, taken by a person with appropriate authority (which may or may not be contractually defined) to declare that some aspect of the project meets defined requirements, thus permitting subsequent activities to proceed.

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

Checklists: Verification checklists that are developed and used during all phases of the commissioning process to verify that the Owner's Project Requirements are being achieved. This includes checklists for general verification, plus testing, training, and other specific requirements.

Commissioning: See *Commissioning Process*.

Commissioning Authority: An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

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

Commissioning Process: A quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

Commissioning Process Activities: Components of the Commissioning Process.

Commissioning Process Progress Report: A written document that details activities completed as part of the Commissioning Process and significant findings from those activities, which is continuously updated during the course of a project. Usually incorporated into the Commissioning Plan as an ongoing appendix.

Commissioning Process Report: A document that records the activities and results of the Commissioning Process. Usually developed from the final Commissioning Plan with all of its attached appendices.

Commissioning Team: The individuals who through coordinated actions are responsible for implementing the Commissioning Process.

Construction Checklist: A form used by the contractor to verify that appropriate components are onsite, ready for installation, correctly installed, and functional. Also see *Checklists*.

Construction Documents: These include a wide range of documents that will vary from project to project and with the Owner's needs and with regulations, laws, and countries. Construction documents usually include the project manual (specifications), plans (drawings), and general terms and conditions of the contract.

Continuous Commissioning Process: A continuation of the Commissioning Process well into the Occupancy and Operations Phase to verify that a project continues to meet current and evolving Owner's Project Requirements. Continuous Commissioning Process activities are ongoing for the life of the facility. Also see *Ongoing Commissioning Process*.

Contract Documents: These include a wide range of documents that will vary from project to project and with the Owner's needs and with regulations, laws, and countries. Contract Documents frequently include price agreements, construction management process, subcontractor agreements or requirements, requirements and procedures for submittals, changes, and other construction requirements, timeline for completion, and the Construction Documents.

Coordination Drawings: Drawings showing the work of all trades to illustrate that equipment can be installed in the space allocated without compromising equipment function or access for maintenance and replacement. These drawings graphically illustrate and dimension manufacturers' recommended maintenance clearances.

Issues Log: A formal and ongoing record of problems or concerns – and their resolution – that have been raised by members of the Commissioning Team during the course of the Commissioning Process.

Nominal Group Technique: A formal, structured brainstorming process used to obtain the maximum possible ranked input from a variety of viewpoints in a short period of time. The typical approach is a workshop session where a question is presented, the attendees record their responses individually on a piece of paper, the individual responses are recorded on a flip chart without discussion in a round robin fashion, all of the responses are discussed, and then the participants rank their top five responses.

Ongoing Commissioning Process: A continuation of the Commissioning Process well into the Occupancy and Operations Phase to verify that a project continues to meet current and evolving Owner's Project Requirements. Ongoing Commissioning Process activities occur throughout the life of the facility; some of these will be close to continuous in implementation, and others will be either scheduled or unscheduled (as needed). Also see *Continuous Commissioning Process*.

Owner's Project Requirements: A written document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. (The term *Project Intent* is used by some owners for their Commissioning Process Owner's Project Requirements.)

Quality Based Sampling: A process for evaluating a subset (sample) of the total population. The sample is based upon a known or estimated probability distribution of expected values; an assumed statistical distribution based upon data from a similar product, assembly, or system; or a random sampling that has scientific statistical basis.^{1, 2, 3}

Re-Commissioning: An application of the Commissioning Process requirements to a project that has been delivered using the Commissioning Process. This may be a scheduled re-commissioning developed as part of an *Ongoing Commissioning Process*, or it may be triggered by use change, operations problems, or other needs.

Retro-Commissioning: The Commissioning Process applied to an existing facility that was not previously commissioned. This guideline does not specifically address retro-commissioning. However, the same basic process needs to be followed from Pre-Design through Occupancy and Operations to optimize the benefits of implementing the Commissioning Process philosophy and practice.

Systems Manual: A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the Owner during the Occupancy and Operations Phase.

Test Procedure: A written protocol that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems.

Training Plan: A written document that details the expectations, schedule, budget, and deliverables of Commissioning Process activities related to training of project operating and maintenance personnel, users, and occupants.

Verification: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.

5. PRE-DESIGN PHASE

5.1 Introduction

5.1.1 Pre-Design is a preparatory phase of the project delivery process in which the Owner's Project Requirements are developed and defined. Information about the project is gathered, including program requirements, community context, codes and regulations, site and climate, facility context and function, facility technology, sustainability, cost, schedule, and the client's (including owner, occupants, operators, and maintenance personnel) needs and capabilities.

5.1.2 This phase is critical to the Commissioning Process because the documented Owner's Project Requirements form the foundation for the design, construction, and occupancy and operation of the facility and are the basis for the Commissioning Plan and schedule. Starting the Commissioning Process during the Pre-Design Phase facilitates project communication by monitoring the Owner's Project Requirements from Pre-Design through Design, Construction, and Occupancy and Operations and by verifying decisions in these phases with the written documents called the Owner's Project Requirements and the Basis of Design.

5.1.3 Pre-Design Phase Commissioning Process objectives include the following:

- (a) Developing the Owner's Project Requirements.
- (b) Identifying a scope and budget for the Commissioning Process.
- (c) Developing the initial Commissioning Plan.
- (d) Acceptance of Pre-Design Phase Commissioning Process activities.
- (e) Review and use of lessons-learned information from previous projects.

5.2 Pre-Design Phase Commissioning Process Activities

5.2.1 Pre-Design Phase Commissioning Process Responsibilities

5.2.1.1 During the Pre-Design Phase, a Commissioning Team is formed to oversee, implement, and accomplish the Commissioning Process activities detailed in this guideline. Responsibility for leadership of the Commissioning Team should be defined and assigned at the beginning of the Pre-Design Phase. The term used for the person with overall responsibility for the Commissioning Process is "Commissioning Authority." The Commissioning Team members must be available for meetings, have the qualifications to contribute to the development of the Owner's Project Requirements, and have the authority to make decisions binding on the firms/constituencies they represent. Lines of authority and lines of communication in determining Commissioning Team members' responsibilities shall be documented. The Commissioning Team composition must be based upon the scope of the Commissioning Process services established for the project.

5.2.1.2 The Owner must assign (or contract for) appropriate representatives to participate on the Commissioning Team – both from within and external to their organization. Commissioning Team responsibilities should be consistent with the agreements between parties involved in the project – and such agreements must clearly address Commissioning Process responsibilities.

5.2.1.3 Essential team members during the Pre-Design Phase include Owner's representatives, the Commissioning Authority, pre-design and programming professionals, design professionals, and (if known) the construction/program/project managers. The Commissioning Authority can assist the Owner in identifying and selecting these initial Commissioning Team members. Owner's representatives will include the project manager, occupants or users, facility manager, and operation and maintenance personnel. Including operation and maintenance personnel on the Commissioning Team will help ensure that important operation and maintenance issues are included in the Owner's Project Requirements. The Owner will generally need to reconcile conflicting project requirements and provide feedback on decisions to the Commissioning Team. The design team members and Commissioning Authority can assist the Owner in reconciling conflicting technical requirements.

5.2.1.4 The Commissioning Team will evolve as a project progresses. During successive phases, the active membership of the Commissioning Team may shift to meet the unique requirements of each phase. Contractors and vendors, for example, may join the Commissioning Team after they are under contract or after the start of construction.

5.2.1.5 Pre-Design Phase Commissioning Process activities described in this section to be performed by the design team must be included in the scope of services described in the "Owner - Design Professional Service Agreement." These Commissioning Process activities may be more than are normally required in their scope of services. The scope of services in the "Owner - Design Professional Service Agreement" should also include the requirement to cooperate with the

Commissioning Authority during Pre-Design, Design, and Construction phases of the project. This may include testing soils, surveying, or other requirements during Pre-Design.

5.2.1.6 Responsibilities of the Commissioning Team during the Pre-Design Phase include the following:

- (a) Assist Owner in preparing requests for project services that outline the roles and responsibilities developed in the Commissioning Plan.
- (b) Facilitate development and documentation of the Owner's Project Requirements.
- (c) Develop scope and format for project Systems Manual and select/designate entity responsible for developing this manual. Add this entity to the Commissioning Team where appropriate.
- (d) Develop scope and budget for project-specific Commissioning Process activities.
- (e) Verify that Commissioning Process activities are clearly stated in all project scopes of work.
- (f) Integrate the Commissioning Process activities into the project schedule.
- (g) Build and maintain cohesiveness and cooperation among the project team.
- (h) Coordinate Owner's representative's participation as defined in Section 5.2.1.2.
- (i) Conduct and document Commissioning Team meetings.
- (j) Identify who will accomplish the Commissioning Process activities.
- (k) Review Pre-Design Phase documents for compliance with the Owner's Project Requirements.
- (l) Write the initial Commissioning Plan.
- (m) Develop the initial format to be used for Issues Logs throughout, and for each phase of, the Commissioning Process.
- (n) Track and document issues and deviations relating to the Owner's Project Requirements and document resolutions in the Issues Log.
- (o) Write and review Commissioning Process Progress Reports.

5.2.2 Develop Owner's Project Requirements

5.2.2.1 The Owner's Project Requirements form the basis from which all design, construction, acceptance, and operational decisions are made. An effective Commissioning Process depends upon a clear, concise, and comprehensive Owner's Project Requirements document. It includes information to help the project team to properly plan, design, construct, operate, and maintain systems and assemblies.

5.2.2.2 The Commissioning Authority facilitates the development of the Owner's Project Requirements. Input will be gathered from all team members.

5.2.2.3 Each item of the Owner's Project Requirements shall have defined performance and acceptance criteria. Those that can be benchmarked should have the benchmark

defined in specific terms and the means of measurement defined.

5.2.2.4 The Owner's Project Requirements should include the following:

- (a) Project schedule and budget.
- (b) Commissioning Process scope and budget.
- (c) Project documentation requirements, including format for submittals, training materials, reports, and the Systems Manual. Consideration should be given to use of electronic format documents and records where appropriate.
- (d) Owner directives.
- (e) Restrictions and limitations.
- (f) User requirements.
- (g) Occupancy requirements and schedules.
- (h) Training requirements for Owner's personnel.
- (i) Warranty requirements.
- (j) Benchmarking requirements.
- (k) Operation and maintenance criteria for the facility that reflect the Owner's expectations and capabilities and the realities of the facility type.
- (l) Equipment and system maintainability expectations, including limitations of operating and maintenance personnel.
- (m) Quality requirements for materials and construction.
- (n) Allowable tolerance in facility system operations.
- (o) Energy efficiency goals.
- (p) Environmental and sustainability goals.
- (q) Community requirements.
- (r) Adaptability for future facility changes and expansion.
- (s) Systems integration requirements, especially across disciplines.
- (t) Health, hygiene, and indoor environment requirements.
- (u) Acoustical requirements.
- (v) Vibration requirements.
- (w) Seismic requirements.
- (x) Accessibility requirements.
- (y) Security requirements.
- (z) Aesthetics requirements.
- (aa) Constructability requirements.
- (ab) Communication requirements.
- (ac) Applicable codes and standards.

(See Table J-1 in Annex J for an example matrix that can assist in the development of Owner's Project Requirements.)

5.2.2.5 Obtaining the information and criteria for the Owner's Project Requirements document requires input from all key facility users and operators. The method used to obtain the information should allow the different user groups and operators to interact. Nominal Group Technique workshops, interviews, and surveys can be used to obtain this input, with decreasing levels of interaction attained, respectively, for each type. See Annex I for additional guidance.

5.2.2.6 The Owner's Project Requirements become part of the Systems Manual documentation.

5.2.2.7 The Owner's Project Requirements is a document that evolves through each project phase. As decisions are made during the Design, Construction, and Occupancy and Operations Phases, this document will be updated to reflect the current project requirements of the Owner. It is the primary tool for benchmarking success and quality at all phases of the project delivery and throughout the life of the facility.

5.2.2.8 Make reference to the Owner's Project Requirements in the bidding documents as "information available to bidders." It must be noted in the contract documents that the Owner's Project Requirements are issued for information only and that this document shall not define, nor shall it be used to interpret, the requirements of the contract.

5.2.2.9 Use quality-based sampling for verification of each activity or task to determine how well it meets or relates to the Owner's Project Requirements in the Pre-Design Phase. This includes programming documents, defined scope-of-design services, special reports and workshop outcomes, and other activities in the Pre-Design Phase.

5.2.3 Identify the scope and budget for the Commissioning Process

5.2.3.1 The scope of the Commissioning Process will vary from one project to another. The Commissioning Team develops the scope for the Commissioning Process. The experiences of the programming team, users, designers, Commissioning Authority, and the Owner with similar and previous facilities and projects can aid in establishing a scope for the Commissioning Process. Additional insight regarding the scope of the Commissioning Process can be obtained from code officials, regulations, published information on similar facilities, and information in the Technical Commissioning Process Guidelines.

5.2.3.2 A well-defined scope permits the establishment of an appropriate budget allocation for the Commissioning Process. The Commissioning Process budget should be realistic, distributed by phase, activity, and entity (Owner, Commissioning Authority, design professional, and contractors), and not subject to reduction without an express change in the Commissioning Plan. Lack of a properly defined and maintained Commissioning Process budget will adversely affect the Commissioning Process and the success of the facility in meeting the Owner's Project Requirements.

5.2.3.3 Typically the Owner will focus the Commissioning Process efforts on selected systems or assemblies based upon the budget, systems or assemblies where the Owner has experienced previous problems, upon complex systems and assemblies, or upon the criticality of the system or assembly in providing for the Owner's Project Requirements. The Commissioning Process can focus upon:

- (a) Substructure: includes basement and foundations.
- (b) Shell: includes superstructure, roof, walls, fenestration, and exterior doors.
- (c) Interiors: includes interior construction, wall, floor, and ceiling finishes, partitions, interior doors, stairways,

hardware, and fitting specialties.

- (d) Services: includes controls, HVAC&R systems, electrical systems, fire and life safety systems and assemblies, security systems, communication systems, plumbing systems, conveying systems, and specialty or technology systems.
- (e) Equipment and furnishings.
- (f) Sitework.
- (g) Landscaping.

5.2.4 Develop the Commissioning Plan

5.2.4.1 The Commissioning Plan identifies processes and procedures necessary for a successful Commissioning Process. The Commissioning Plan addresses the Owner's Project Requirements and reflects the defined scope and budget for the Commissioning Process.

5.2.4.2 The Commissioning Plan includes a schedule of Commissioning Process activities, individual responsibilities, documentation requirements, communication and reporting protocols, and evaluation procedures. Evaluation procedures include the review and verification to the Owner's Project Requirements of the design documents, contract documents, construction and test procedures.

5.2.4.3 The Commissioning Plan is continually updated during the life of a project to reflect changes in planning, design, construction, and occupancy and operations. During the Pre-Design Phase, the Commissioning Plan focuses upon the scope of the Commissioning Process during the Design Phase. The Construction Phase and Occupancy and Operations Phases are included, but details are usually added during the Design Phase for the Construction and Occupancy and Operations Phases—see Sections 6.2.3 and 7.2.5.

5.2.4.4 The Commissioning Plan contains the following information:

- (a) Overview of the Commissioning Process developed specifically for the project.
- (b) Roles and responsibilities for the Commissioning Team throughout the project and specifically during the Pre-Design and Design Phases. The roles shall differentiate the areas with which each of the members is involved, and the responsibilities shall detail the specific tasks that are to be completed by the individual members.
- (c) Documentation of general communication channels to be used throughout the project. Design Phase procedures should be clearly documented during the Pre-Design Phase.
- (d) Detailed description of Commissioning Process activities and a schedule of activities during the Pre-Design and Design Phases. The milestones should include the Commissioning Team meetings, Owner's Project Requirements development, design review periods, and the completion of the Basis of Design and the commissioning specifications.
- (e) General description of Commissioning Process activities that will occur during the Construction and Occupancy and Operations Phases.
- (f) Guidelines and format that will be used to develop the

Commissioning Process documentation that facilitates communication among the Commissioning Team and all other parties involved in the project.

- (g) Commissioning Process forms that will be used during the Pre-Design and Design Phases to communicate and track critical Commissioning Process information.
- (h) Project design document verification procedures.
- (i) The framework for procedures to follow whenever Commissioning Process verification does not meet the Owner's Project Requirements.
- (j) Quality-based sampling procedures for verification of achieving the Owner's Project Requirements during all project phases.

5.2.4.5 If properly developed, the Commissioning Plan forms the core of the Final Commissioning Process Report.

5.2.5 Establish Issues Log Procedures

5.2.5.1 An Issues Log contains detailed descriptions of design, installation, or performance issues that are at variance with the Owner's Project Requirements. Issues are identified and tracked as they are encountered during the design, construction, and operation of a facility. It is recommended that an Issues Log be maintained with the status of all current and resolved issues. The information outlined in 5.2.5.2 and 5.2.5.3 should be documented in the Issues Log as a minimum.

5.2.5.2 Information to be documented at the time an issue is identified includes:

- (a) Unique numeric or alphanumeric identifier by which the issue may be tracked.
- (b) Short, descriptive title of the issue.
- (c) Date and time of the identification of the issue.
- (d) Test number of the test being performed at the time of the observation, if applicable, for cross-reference.
- (e) Identification of system, equipment, or assembly to which the issue applies.
- (f) Location of the issue.
- (g) Description of the observed design, installation, or performance issue, including any information that may be helpful in diagnosing or evaluating the issue.
- (h) Recommended corrective action, if apparent.
- (i) Identification of the Commissioning Team member responsible for resolution of the issue, if apparent.
- (j) Expected date of correction.
- (k) Name of the person documenting the issue.

5.2.5.3 Information to be documented when an issue is resolved:

- (a) Date of completion of resolution.
- (b) Description of corrective action taken. Include description of diagnostic steps taken to determine the root cause of the issue and the value of resolving the Commissioning Process issue for the owner, design team, contractor, or occupant.
- (c) Identification of changes to the Owner's Project Requirements or Basis of Design that require action (if any).

- (d) Statement that the correction was completed and the system or assembly is ready for retest, if applicable.
- (e) Name of the person who resolved the issue.
- (f) Name of person documenting the issue resolution.

5.2.6 Prepare Issues Report

5.2.6.1 On a periodic basis, at least for each Commissioning Team meeting, a report shall be generated for review of outstanding issues. The following information should be included:

- (a) Issue number.
- (b) Short, descriptive title of the issue.
- (c) Date of the identification of the issue.
- (d) Name of the Commissioning Team member assigned responsibility for resolution.
- (e) Expected date of correction.

5.2.7 Prepare Commissioning Process Progress Reports

5.2.7.1 Commissioning Process Progress Reports are periodic reports of the status of Commissioning Process activities throughout the project and become part of the Commissioning Process Report. Commissioning Process Progress Reports should cover the following information:

- (a) Commissioning Process activities completed since the last report, including the current status of Pre-Design project activities.
- (b) Description of changes to the Commissioning Process schedule (e.g., early completion of or delays in work and early or late delivery of items that impact the Commissioning Process activities), Commissioning Plan, and design, along with their effect on the Owner's Project Requirements and Basis of Design.
- (c) Include new and outstanding issues and list those that have been resolved since the last Progress Report, including a brief description of actions taken to resolve the issues. Also include planned activities to resolve outstanding issues expeditiously.
- (d) Commissioning Process activities anticipated during the period before the next Progress Report.

5.2.7.2 The frequency of Commissioning Process Progress Reports depends upon the amount of work being accomplished and could vary from every two weeks to every six months. A general guide to follow is one progress report for every four Commissioning Team meetings.

5.3 Pre-Design Phase Acceptance Requirements

5.3.1 During the Pre-Design Phase the Commissioning Process should include the formal acceptance by the Owner of the Owner's Project Requirements and the Commissioning Plan.

5.4 Pre-Design Phase Documentation

5.4.1 The Commissioning Process scope and budget, Owner's Project Requirements, the Commissioning Plan, Issues Log and reports, and Commissioning Process Progress Reports are the primary documentation requirements for the Pre-Design Phase Commissioning Process.

5.4.2 The information in the Owner's Project Requirements and the Commissioning Plan is used throughout subsequent project phases (including Occupancy and Operations).

5.5 Pre-Design Phase Training Identification Requirements

5.5.1 Training requirements for facility, system, and assembly operation and maintenance are addressed in the Owner's Project Requirements.

6. DESIGN PHASE

6.1 Introduction

6.1.1 During the Design Phase of the project delivery process, the Owner's Project Requirements are translated into construction documents. A document called the Basis of Design is created that clearly conveys the assumptions made in developing a design solution that fulfills the intent and criteria in the Owner's Project Requirements document. Narrative descriptions of facility systems and assemblies are developed and included in the Basis of Design, and the Commissioning Plan is expanded to include the details of Construction and Occupancy and Operations Phase activities.

6.1.2 Design Phase Commissioning Process objectives include the following:

- (a) Verifying the Basis of Design document with the Owner's Project Requirements document.
- (b) Updating the Commissioning Plan to include Construction and Occupancy and Operations Phase Commissioning Process activities.
- (c) Developing Commissioning Process requirements for inclusion in the Construction Documents.
- (d) Developing draft Construction Checklists.
- (e) Updating the scope and format of the project Systems Manual.
- (f) Defining training requirements.
- (g) Performing commissioning-focused design review.
- (h) Acceptance of Design Phase Commissioning Process activities.

6.1.3 Design Phase Commissioning Process activities described in this section that are to be performed by the design team and special consultants must be included in the scope of services described in the "Owner - Design Professional Service Agreement." These Commissioning Process activities may be more than are normally required in their scope of services. The scope of services in the "Owner - Design Professional Service Agreement" should also include the requirement to cooperate with the Commissioning Authority during Pre-Design, Design, and Construction phases of the project. This may include testing soils, evaluating or checking existing conditions, surveying, or other requirements during Design.

6.1.4 Use quality-based sampling for verification of each activity or task determined to be related to the Owner's Project Requirements in the Design Phase.

6.1.5 If the Commissioning Process on a particular project starts at the Design Phase, then the Commissioning Process

activities described for the Pre-Design Phase must be completed before the following Design Phase activities are begun.

6.2 Design-Phase Commissioning Process Activities

6.2.1 Design-Phase Commissioning Process Responsibilities

6.2.1.1 During the Design Phase, the Commissioning Team works to verify that the Construction Documents meet and properly convey the Owner's Project Requirements.

6.2.1.2 Essential team members during the Design Phase include the Owner's representatives, the Commissioning Authority, design professionals, and construction/program/project managers (if known).

6.2.1.3 Responsibilities of the Commissioning Team during the Design Phase include the following:

- (a) Build and maintain cohesiveness and cooperation among the project team.
- (b) Assist Owner in preparing requests for project services that outline the Commissioning Process roles and responsibilities developed in the Commissioning Plan.
- (c) Verify that Commissioning Process activities are clearly stated in all project scopes of work.
- (d) Develop the scope and budget for project-specific Commissioning Process activities.
- (e) Identify specialists who will be responsible for accomplishing the Commissioning Process activities for specific systems and assemblies.
- (f) Conduct and document Commissioning Team meetings.
- (g) Inform all Commissioning Team members of decisions that result in modifications to the Owner's Project Requirements.
- (h) Integrate the Commissioning Process activities into the project schedule.
- (i) Track and document issues and deviations relating to the Owner's Project Requirements and document resolutions in the Issues Log.
- (j) Verify documentation and updating of the Basis of Design.
- (k) Develop Construction Checklists.
- (l) Develop Construction and Occupancy and Operations Phase test requirements.
- (m) Develop training program requirements.
- (n) Document Commissioning Process requirements and integrate them into the contract documents.
- (o) Update the Commissioning Plan.
- (p) Review Design Phase documents for compliance with the Owner's Project Requirements.
- (q) Update the Owner's Project Requirements.
- (r) Write and review Commissioning Process Progress Reports.

6.2.2 Basis of Design Documentation

6.2.2.1 The Basis of Design, developed and updated throughout the Design Phase, is required with each design submission and should include the following:

- (a) System and assembly options.

- (b) System and assembly selection reasoning.
- (c) Facility, system, and assembly performance assumptions:
 - (i) Assumptions for calculations/sizing.
 - (ii) Analytical procedures and tools.
 - (iii) Environmental conditions.
 - (iv) Limiting conditions.
 - (v) Reference make and model.
 - (vi) Operational assumptions.
- (d) Narrative system and assembly descriptions.
- (e) Codes, standards, guidelines, regulations, and other references.
- (f) Owner guidelines and directives.
- (g) Specific descriptions of systems and assemblies.
- (h) Consultant, engineering, and architectural guidelines for design developed by the design team or others.

6.2.2.2 The Basis of Design documents how each criterion in the Owner's Project Requirements is implemented in the design. For any criterion that could not be met, documentation detailing what was done, its impact on the Owner's Project Requirements, and how the Owner's Project Requirements was modified shall be included.

6.2.3 Update Commissioning Plan

6.2.3.1 The Commissioning Plan must be updated to reflect changes in the Owner's Project Requirements and include additional information developed during the Design Phase.

6.2.3.2 During the Design Phase, the following is added to or updated in the Commissioning Plan:

- (a) Systems and assemblies to be verified and tested.
- (b) Schedule of Construction Phase and Occupancy and Operations Phase Commissioning Process activities.
- (c) Roles and responsibilities of new Commissioning Team members.
- (d) Construction Phase and Occupancy and Operations Phase documentation and reporting requirements, including procedures and formats.
- (e) Construction Phase and Occupancy and Operations Phase communication protocols.
- (f) Construction Phase and Occupancy and Operations Phase Commissioning Process procedures.

6.2.3.3 The milestones to be incorporated in the schedule should include the pre-bid meeting, pre-construction meeting, Commissioning Team meetings, training sessions, shop drawing submittals, Systems Manual submittal, special tests or code official inspection and acceptance, tests, test periods, substantial completion, occupancy, seasonal testing, initial Commissioning Process Report submittal, warranty review two months prior to end of warranty period, lessons-learned meeting, and final Commissioning Process Report.

6.2.3.4 The Construction Phase and Occupancy and Operations Phase roles and responsibilities of the individual members of the Commissioning Team, including any new members, should be clearly defined based upon the unique experience and knowledge of the team members. Professional

and services agreements must be modified to reflect the scope of work.

6.2.3.5 The Commissioning Plan must define the documentation that will be required as part of the Commissioning Process during the Construction Phase and Occupancy and Operations Phase. This includes the specific formats to be used (electronic/paper, software program and version), the information to be included, the frequency of submittal, and the distribution.

6.2.3.6 The communication protocols to be used during the Construction Phase and Occupancy and Operations Phase shall be clearly defined in the Commissioning Plan. This includes how the flow of information among the team members will be coordinated and distributed.

6.2.3.7 The Commissioning Process procedures to be implemented during the Construction Phase and Occupancy and Operations Phase must be clearly documented in the Commissioning Plan. These include:

- (a) Review of submittals.
- (b) Scheduling and holding of meetings.
- (c) Site visit procedures.
- (d) Issues identification, documentation, tracking, and resolution.
- (e) Construction Phase test preparation, implementation, and follow-up.
- (f) The responsibilities of each member of the Commissioning Team.
- (g) Who is responsible for costs related to verification and testing—including re-testing or verification activities.
- (h) Systems Manual development and review.
- (i) Training program.
- (j) Occupancy and Operations Phase test preparation, implementation, and follow-up.

6.2.3.8 The test procedure requirements developed during the Design Phase are general in nature, structure, and complexity but must clearly convey the level and amount of testing (see Section 7.2.9) required by manufacturers and contractors.

6.2.4 Commissioning Process Requirements in the Construction Documents

6.2.4.1 The Commissioning Process requires that certain quality-assurance and quality-control procedures, envisioned in the Commissioning Plan, be performed as part of the construction contract.

6.2.4.2 The Owner's Project Requirements should be included in the Contract Documents and labeled as for "Informational Purposes Only" to differentiate it from the contractor's contractual obligations. In addition, as much Basis of Design information should be included in the Contract Documents as possible. This information is included in the Contract Documents to aid the contractors in understanding the design, material requirements, sustainability and energy goals, and the desired use and intent of the facility. Such information aids in the successful implementation of the Commissioning Process but does not relate directly to the contract requirements.

6.2.4.3 Specific Commissioning Process requirements are included in the contract specifications. For this guideline, specification division numbers and section titles consistent with the Construction Specifications Institute MasterFormat® are used. This is done to simplify a lengthy list of specification requirements. Commissioning Process activities that address systems and assemblies need to be included in Division 1 sections and those that address equipment and components need to be included in Divisions 2 through 16.

- (a) The obligations to perform Commissioning Process activities must be documented in the contract between the Owner and Contractor.
- (b) Detailed scope and responsibilities of the Contractor shall be included in the “Summary of Work” section in Division 1.
- (c) The Commissioning Process requirements for documentation, training, and testing facility systems and assemblies are integrated into commissioning sections in Division 1.
- (d) Specific equipment and component performance documentation requirements and use of Construction Checklists should be integrated into specification sections in Divisions 2 through 16, with appropriate cross-references.

6.2.4.4 The Commissioning Process activities to be integrated include:

- (a) Performance, installation, and operations information requirements as part of shop drawing submittals in Divisions 2 through 16 sections.
- (b) Completion of Construction Checklists in Division 1 and references to Division 1 in Divisions 2 through 16 sections.
- (c) Contractor involvement in the Commissioning Team in Division 1.
- (d) Test requirements in Division 1.
- (e) Training program development and implementation requirements in Division 1.
- (f) Systems Manual requirements in Division 1.

6.2.4.5 A guide specification section template for general Commissioning Process requirements in Division 1 is included in Annex L.

6.2.5 Construction Checklists

6.2.5.1 Construction Checklists aid the installers by providing specific information on the Owner’s Project Requirements for equipment and assemblies for long-term operation. Checklists typically include:

- (a) Equipment/assembly verification.
- (b) Pre-installation checks.
- (c) Installation checks.
- (d) Any negative responses.

6.2.5.2 The first section of the Checklist is equipment/assembly verification. This section should include vital information on the equipment or materials being supplied (specific listings of vital information are included in the technical guidelines developed for various facility systems). This section contains information on what equipment/material was

specified/submitted and space to document/verify what was actually delivered to the site.

6.2.5.3 The pre-installation section of the Checklist is utilized to verify the condition of the equipment/material at the site immediately prior to its installation.

6.2.5.4 The installation section of the Checklist is utilized to verify proper installation. This section focuses on the ability of the installation to meet the Construction Documents and the Owner’s Project Requirements. For equipment, this section focuses on the physical installation and its start-up when applicable. For assemblies, the focus is typically on installation and performance.

6.2.5.5 The negative responses section is a space provided to document the reason for any negative responses and whether any action has been taken to correct the problem or problems that led to the negative responses.

6.2.5.6 Whenever a test data form is required for a specific system or assembly, there should be an item in the associated Construction Checklist for the test data form to be submitted to the Commissioning Authority.

6.2.5.7 Construction Checklists should be kept as short as possible and the questions should be worded clearly so that the correct answer is typically yes.

6.2.5.8 Construction Checklists are used by the Commissioning Team to verify that the installation meets the Owner’s Project Requirements. They can also be used by the contractors to track progress of construction against the schedule of values.

6.2.5.9 Annex M contains sample formats for Construction Checklists.

6.2.6 Systems Manual

6.2.6.1 The Systems Manual should provide the information needed to understand, operate, and maintain the systems and assemblies and to inform those not involved in the design and construction process about the systems and assemblies. The Systems Manual should be the repository of information on updates and corrections to systems and assemblies as they occur during the Occupancy and Operations Phase.

6.2.6.2 The Systems Manual expands the scope of the traditional operating and maintenance documentation to include the additional information gathered during the Commissioning Process and to provide a systems-based organization of information.

6.2.6.3 Contractor documentation requirements for the Systems Manual shall be clearly stated in the Construction Documents.

6.2.6.4 The following should be included in the Systems Manual (see Annex O for an example format):

- (a) Index of Systems Manual with notation as to content storage location if not in actual manual.
- (b) Executive Summary.
- (c) Owner’s Project Requirements.
- (d) Basis of Design documents.
- (e) Construction Record Documents, specifications, and approved submittals.
- (f) A list of recommended operational record-keeping pro-

cedures, including sample forms, logs, or other means, and a rationale for each.

- (g) Ongoing optimization guidance.
- (h) Operations and maintenance manuals (includes operating procedures for all normal, abnormal, and emergency modes of operation; maintenance procedures; parts and recommended spare parts list; troubleshooting guide; and systems schematics (one-line diagrams).
- (i) Training materials.
- (j) Commissioning Process Report.

6.2.7 Training Requirements

6.2.7.1 During the Design Phase, the training requirements of the operations and maintenance personnel and occupants are identified relative to the systems and assemblies to be installed in the facility. It is critical that the operations and maintenance personnel have the knowledge and skills required to operate the facility to meet the Owner's Project Requirements. The occupants need to understand their impact on the use of the facility and its ability to meet the Owner's Project Requirements.

6.2.7.2 These training requirements can be obtained using a Nominal Group Technique workshop, interviews, or surveys. The requirements are obtained after the systems and assemblies have been decided upon, and prior to issuance of the Construction Documents, to ensure that the requirements for training are clearly conveyed in the Construction Documents. The results of the workshop, interviews, or surveys should address the following:

- (a) The systems, subsystems, equipment, and assemblies for which training will be required.
- (b) The capabilities and knowledge of the occupants and operations and maintenance personnel.
- (c) The number and type of training sessions. The training program should be organized into a series of instructional modules, each covering a portion of the facility's systems, equipment, and assemblies.
- (d) Measurable learning objectives and teaching outlines should be developed to clearly describe the specific skills and knowledge that the participant is expected to master.

6.2.7.3 The first training session should be general in nature for the operations and maintenance personnel and the occupants, and it should review the Owner's Project Requirements and the Basis of Design. This provides the background on why the facility is being constructed and its limitations.

6.2.7.4 The majority of training should be planned to be accomplished during the Construction Phase and prior to substantial completion.

6.2.7.5 Training during the Occupancy and Operations Phase may be required for certain systems and assemblies to achieve or maintain the Owner's Project Requirements.

6.2.7.6 The Systems Manual has a close functional relationship with personnel training. A meaningful and useful training program typically includes using the operation and maintenance components of the Systems Manual as the basis of development.

6.2.7.7 Review of documentation during training consists of reviewing the content of emergency, operation, and maintenance information in the Systems Manual, project Record Documents, system and equipment identification systems, warranties, and maintenance service agreements contained in the Systems Manual. Training should specifically address:

- (a) Emergency instructions and procedures: those required for operating the facility during various emergencies, including step-by-step instructions for each type of emergency.
- (b) Operation instructions and procedures: the procedures required for normal operation of the facility, including step-by-step instructions for day-to-day operation.
- (c) Adjustment instructions: information for maintaining operational parameters.
- (d) Troubleshooting procedures: instructions for diagnosing operating problems and procedures for testing and inspecting.
- (e) Maintenance and inspection procedures.
- (f) Repair procedures: instructions for diagnosing problems and for disassembly, component removal, replacement, and reassembly.
- (g) Upkeep of the Systems Manual and associated maintenance documentation and logs.

6.2.7.8 In the specifications, as a minimum, define the time requirements for each type of system/assembly that requires demonstration and training or include an allowance for demonstration and training capabilities. Also include the expected experience and knowledge of trainer, the number of unique training sessions, the need for repeating the training for multiple shifts, and submittal of Training Plan, handouts, record of the training, and electronic recording of on-site training.

6.2.7.9 Training materials should include or utilize the following items:

- (a) Copy of the Training Plan including schedule, syllabus, and agenda.
- (b) Systems Manual.
- (c) Manufacturers' training manuals.
- (d) Electronic media or videotapes of manufacturers' or vendors' training and service materials.

6.2.8 Review of Design Professional Submittals

6.2.8.1 Complete targeted design reviews at strategic times during the Design Phase. All design issues should be resolved prior to continuing with design.

6.2.8.2 A targeted design review is composed of four tasks:

- (a) General quality review of the documents, including legibility, consistency, and level of completeness.
- (b) Coordination between disciplines.
- (c) Discipline-specific review for achieving the Owner's Project Requirements.
- (d) Specification applicability and consistency with Owner's Project Requirements and Basis of Design.

6.2.8.3 The general quality of the documents is evaluated by checking for consistent layout and legibility of the Design Professional Submittal and Construction Documents. Compliance with the Owner's Project Requirements along with ease of use and clarity are the major issues to check when looking at the complete package. This review looks for completeness of the drawings and for items of concern identified during previous reviews.

6.2.8.4 Sample areas of the facility, 10-20% of the total area, are reviewed in detail to evaluate the coordination accomplished within and among disciplines. This includes reviewing for constructability and interfaces among disciplines. The intent of this review is to determine if there are systematic errors, not to fully check the drawings. The responsibility for complete checking of the drawings for coordination and accuracy remains with the Design Team.

6.2.8.5 A discipline-specific review involves a review of the Construction Documents along with the Basis of Design, design calculation assumptions, and methods for compliance with the Owner's Project Requirements. A sampling strategy of focusing upon 10-20% of the drawings provides for an in-depth analysis and evaluation of the ability of the documents to meet the Owner's Project Requirements.

6.2.8.6 A review of the specifications is performed to determine completeness and applicability to the project. A review of 10-20% of the specification is performed in detail for verification of compliance with the Owner's Project Requirements. Items checked include applicability of the section to the project, Commissioning Process requirements, submittal requirements, applicability of equipment, training requirements, and coordination with other sections.

6.2.8.7 See Annex N for additional guidance on how to accomplish quality-based design reviews.

6.3 Design Phase Acceptance Requirements

6.3.1 The Commissioning Process should include the formal acceptance by the Owner of the Basis of Design and the updated Owner's Project Requirements during the Design Phase, following review and comment by the Commissioning Authority.

6.4 Design Phase Documentation Requirements

6.4.1 Construction Document commissioning requirements, updated Owner's Project Requirements, updated Commissioning Plan, the updated Issues Log, and the Commissioning Process Progress Reports are the primary documentation requirements for the Design Phase Commissioning Process.

6.4.2 The information in these deliverables is used throughout subsequent project phases (including Occupancy and Operations).

6.5 Design Phase Training Identification Requirements

6.5.1 Training requirements for facility, system, and assembly operation and maintenance are addressed during the Design Phase by the completion of a training requirements identification workshop, development of the Construction Phase and Occupancy and Operations Phase training pro-

gram, and inclusion of the training program requirements in the Commissioning Plan and Construction Documents.

7. CONSTRUCTION PHASE

7.1 Introduction

7.1.1 During the Construction Phase of the project delivery process, systems and assemblies are installed, inspected, tested, and placed into service to meet the Owner's Project Requirements. This phase may also include bidding, negotiation, and contracting activities. The Systems Manual is delivered during this phase and training is provided.

7.1.2 Construction Phase Commissioning Process objectives include the following:

- (a) Updating the Owner's Project Requirements.
- (b) Updating the Commissioning Plan.
- (c) Verifying that submittals meet the Owner's Project Requirements.
- (d) Developing detailed test procedures and data forms.
- (e) Verifying that systems and assemblies comply with the Owner's Project Requirements.
- (f) Delivering the Systems Manual.
- (g) Verifying training of the Owner's operation and maintenance personnel and occupants.
- (h) Acceptance of Construction Phase Commissioning Process activities.

7.1.3 Construction Phase Commissioning Process activities described in this section that are to be performed by the design team and special consultants must be included in the scope of services described in the "Owner – Design Professional Service Agreement." These Commissioning Process activities may be more than are normally required in their scope of services. The scope of services in the "Owner - Design Professional Service Agreement" should also include the requirement to cooperate with the Commissioning Authority during Pre-Design, Design, and Construction phases of the project. This may include material testing, TAB, performance tests, records, photography, outside training, Owner's furnished equipment vendors, and other requirements during the Construction Phase.

7.1.4 If the Commissioning Process on a particular project starts at the Construction Phase, Commissioning Process activities described for the Pre-Design and Design Phases must be completed before the following Construction Phase activities are begun.

7.2 Construction Phase Commissioning Process Activities

7.2.1 Construction Phase Commissioning Process Responsibilities

7.2.1.1 During the Construction Phase, the Commissioning Team works to verify that systems and assemblies are installed in a manner that will achieve the Owner's Project Requirements.

7.2.1.2 Use quality-based sampling for verification of each task and test determined to be related to the Owner's Project Requirements during the Construction Phase.

7.2.1.3 Conduct and document regularly scheduled Commissioning Team meetings to facilitate coordination and cooperation in delivering a facility that meets the Owner's Project Requirements.

7.2.1.4 Essential team members during the Construction Phase include Owner's representatives, the Commissioning Authority, design professionals, contractors, suppliers/vendors, and construction/program/project managers.

7.2.1.5 Responsibilities of the Commissioning Team during the Construction Phase include the following:

- (a) Participate in the pre-bid conference.
- (b) Coordinate participation of Owner's representatives.
- (c) Identify specialists who will be responsible for accomplishing the Commissioning Process activities for specific systems and assemblies.
- (d) Update the Owner's Project Requirements to reflect decisions made during bidding and construction.
- (e) Update the Commissioning Plan.
- (f) Conduct a pre-construction Commissioning Process meeting.
- (g) Review the following submittals for compliance with the Owner's Project Requirements: coordination drawings, shop drawings, product data, preliminary Systems Manual, and training program.
- (h) Schedule the Commissioning Process activities and integrate them into the project construction schedule.
- (i) Address schedule changes.
- (j) Develop and document test procedures and data forms.
- (k) Conduct and document ongoing Commissioning Team meetings.
- (l) Monitor compliance with the Owner's Project Requirements through periodic site visits.
- (m) Verify completion of items indicated in the Construction Checklists.
- (n) Witness tests.
- (o) Verify tests.
- (p) Verify test data reports.
- (q) Verify training of operation and maintenance personnel and occupants according to the Owner's Project Requirements.
- (r) Identify, diagnose, and track issues and deviations relating to the Owner's Project Requirements and document resolution of same.
- (s) Write and review Commissioning Process Progress Reports.
- (t) Review construction progress reports.
- (u) Verify incorporation of new equipment and systems into the maintenance management program.
- (v) Verify updates to the Basis of Design documentation.
- (w) Verify updates to the Systems Manual.
- (x) All Commissioning Team members are responsible for keeping the Commissioning Team informed of decisions that result in modifications to the Owner's Project Requirements.

- (y) Review contract modifications for compliance with Owner's Project Requirements.

7.2.2 Pre-bid Conference

7.2.2.1 Time should be allotted during the pre-bid conference for the Commissioning Team to alert bidders to Commissioning Process requirements with which they may not be familiar.

7.2.3 Coordinate Owner's Representatives Participation

7.2.3.1 Coordinate and schedule participation of Owner's representatives in Commissioning Process activities. Owner representatives may vary from one activity to another, both in number and in the specific individuals. It is important for Owner's representatives to participate in Commissioning Team meetings, review of commissioning process reports, discussions of changes to the Owner's Project Requirements, and staff and occupant training. Other Commissioning Process activities in which Owner's representatives typically participate include reviewing submittals and witnessing testing.

7.2.4 Update Owner's Project Requirements

7.2.4.1 Changes to the Owner's Project Requirements during bidding and the Construction Phase may be initiated as the result of Owner-directed changes to the Owner's Project Requirements or design/construction process-initiated changes to the Construction Documents.

7.2.4.2 When the Owner initiates a change to the Owner's Project Requirements, the design shall be modified and reviewed as necessary to meet the change in the Owner's Project Requirements.

7.2.4.3 When the Owner considers changes initiated through the design/construction process, the Commissioning Team should review the proposed changes to determine if they compromise the Owner's Project Requirements, paying special attention to the functional impacts of value management proposals. If the Owner chooses to initiate a change after reviewing the Commissioning Team's comments, the Owner's Project Requirements must be updated as necessary to match the change.

7.2.5 Update the Commissioning Plan

7.2.5.1 Update the Commissioning Plan to include new or revised descriptions of Commissioning Process activities during the Construction Phase. Incorporate the following:

- (a) Test procedures and data forms developed during the Construction Phase.
- (b) Refinement and integration of Commissioning Process activities in the construction schedule.
- (c) Roles and responsibilities of the Commissioning Team during the Construction Phase, including the identification of new team members.
- (d) Identification of specialists responsible for accomplishing Commissioning Process activities for specific systems and assemblies.
- (e) Changes to the communication channels and procedures to be used during the Construction Phase.

7.2.6 Conduct Pre-Construction Commissioning Process Meeting

7.2.6.1 Early in the Construction Phase, the Commissioning Authority shall conduct a pre-construction Commissioning Process meeting with the Commissioning Team.

7.2.6.2 During the pre-construction meeting, the Owner's Project Requirements, Basis of Design, and unique contract document requirements are reviewed. In addition, the specific roles and responsibilities of the contractors relative to the Commissioning Process activities are reviewed.

7.2.7 Verify Submittals

7.2.7.1 It is recommended that a sampling strategy of randomly selecting 5% to 10% of the submittal be used to focus upon the quality and ability of the submittal to achieve the Owner's Project Requirements. If deviations are substantial, then review an additional 5% to 10%. If substantial deviations still exist, then reject the submittal and return it with comments.

7.2.7.2 Concurrent with Design Team and Owner review, a designated Commissioning Team member reviews coordination drawings, shop drawings, and project submittals for compliance with the Owner's Project Requirements. Special attention must be paid to substitutions and proposed deviations from the Contract Documents and the Basis of Design that could adversely impact the Owner's Project Requirements.

7.2.7.3 Upon receipt, designated members of the Commissioning Team shall review the Systems Manual for compliance with the Contract Documents and the Owner's Project Requirements.

7.2.7.4 Review training program, materials, and schedule, and monitor delivery of training to verify that it meets the Owner's Project Requirements for the preparation of operations and maintenance personnel.

7.2.7.5 Training records are reviewed by designated members of the Commissioning Team for proper documentation of attendees, material covered, and associated details.

7.2.8 Schedule Commissioning Process Activities

7.2.8.1 The objective of scheduling Commissioning Process activities is to integrate and coordinate them with other Construction Phase activities and to allow all Commissioning Team members to plan their work to achieve the Owner's Project Requirements. Commissioning Process activities should be integrated into the construction schedule. Detailed integration of commissioning work with the construction schedule is critical to maintaining project schedule milestones.

7.2.8.2 The project schedule needs to include the start date, duration, description, and entity responsible for completion.

7.2.8.3 As a minimum, the following should be included in the project schedule:

- (a) Commissioning Team meetings.
- (b) Start and completion of each construction phase.
- (c) Key system and assembly completion and tests.
- (d) Training sessions.
- (e) Substantial completion.
- (f) Warranty start date.

(g) Occupant move-in.

(h) Warranty review two months prior to end of warranty period.

(i) Lessons-learned meeting.

7.2.9 Develop Test Procedures

7.2.9.1 Test Procedures define the means and methods to carry out the tests that are accomplished during the Construction Phase. Test Procedures provide the following:

- (a) Participants required for the test, which may include the primary contractor, secondary contractors, design professionals, the Commissioning Authority, operators, the local authority having jurisdiction, and manufacturers associated with the equipment, system, or assembly.
- (b) Prerequisites for the test performance in terms of completion of systems and assemblies and acceptable completion of other activities.
- (c) Step-by-step instructions to exercise the specific systems and assemblies under test. Instructions include how to configure the system or assembly to start the test and how to restore the system to normal operation at the conclusion of the test.
- (d) List of instrumentation, tools, and supplies required for the test. The list should indicate which of the participants is responsible for each of the items listed. The list should be specific as to make, model, range, capacity, accuracy, calibration, and other pertinent performance requirements.
- (e) An indication, for each step of the procedure, of what observations or measurements must be recorded and the range of acceptable results.

7.2.9.2 The Commissioning Team will develop a range of test verification procedures. These procedures include:

- (a) Component test procedures: Component test procedures verify the performance of components under a full range of actions, responses to inputs, and loads.
- (b) System/assembly test procedures: System/assembly test procedures verify the performance of subsystems, systems, and assemblies under a full range of operating conditions (both normal and emergency), responses to inputs, and loads.
- (c) Intersystem test procedures: Intersystem test procedures verify the interactions between systems and assemblies.
- (d) Owner's Project Requirements test procedures: Owner's Project Requirements test procedures verify that the various systems and assemblies that comprise the facility deliver the intended Owner's Project Requirements at the point of use.
- (e) Use quality-based sampling for verification of each test determined to be related to the Owner's Project Requirements.

7.2.9.3 In developing the Test Procedures, special attention must be paid to issues of personnel safety, equipment/assembly protection, and manufacturer's recommendations to protect the validity of the warranty.

7.2.10 Develop Test Data Records

7.2.10.1 Test Data Records capture test data, observations, and measurements. Data may be recorded on photographs, forms, or other means appropriate for the application. The following minimum information should be recorded:

- (a) Test number.
- (b) Date and time of the test.
- (c) Indication of whether the record is for a first test or retest following correction of a problem or issue.
- (d) Identification of the system, equipment, or assembly under test. List the location and the construction document designation.
- (e) Conditions under which the test was conducted. For example, when testing, fully describe the ambient conditions, setpoints, overrides, and the status and operating condition of devices, systems, and equipment that impact the results of the test.
- (f) Expected performance of the systems and assemblies at each step of the test.
- (g) Observed performance of the system, equipment, or assembly at each step of the test. When data forms are used, check boxes generally do not adequately describe the system performance and therefore should be avoided in most cases. A blank space in which the observed or measured performance may be described provides more information for diagnostics and a future baseline for performance.
- (h) Notation to indicate whether the observed performance at each step meets the expected results.
- (i) Other observations about system performance or test procedure.
- (j) Issue number, if any, generated as a result of the test.
- (k) Dated signatures of the person performing the test and of the witness, if applicable.

7.2.11 Commissioning Team Meetings

7.2.11.1 Consistent, periodic Commissioning Team meetings are essential to maintaining the progress of the project.

7.2.11.2 The schedule of meetings should be documented as early as possible during the Construction Phase and updated as required due to schedule changes. The meeting dates and times should be known a minimum of two weeks in advance and should be coordinated with other meetings to minimize travel time and costs for various attendees.

7.2.11.3 Team members represented at the meeting must be authorized to make commitments and decisions for their respective organizations to facilitate an effective Commissioning Team meeting.

7.2.11.4 Prior to a meeting (usually a minimum of three days) an agenda should be distributed to all invited attendees. The agenda should include:

- (a) Meeting location.
- (b) Start time.
- (c) List of invited attendees.
- (d) List of items to cover (previous action items, outstanding

ing issues, schedule review, new issues, and other business) along with defined time allotments for each item.

- (e) End time.
- (f) Attachments, if applicable.

7.2.11.5 The meeting time and duration should be strictly adhered to. This will set the tone for other Commissioning Process activities.

7.2.11.6 Within a reasonable and established period (frequently, three days) after the meeting, distribute meeting notes or minutes. This should include:

- (a) Date, time, and location of the meeting.
- (b) List of attendees.
- (c) Resolved action items and issues.
- (d) Outstanding action items and issues, including clear identification of the responsible party and due dates.
- (e) Date, time, and location of the next meeting.

7.2.12 Accomplish Periodic Site Visits to Verify Compliance with the Owner's Project Requirements

7.2.12.1 Site visits are the primary method used during the Construction Phase to verify that the installed systems and assemblies comply with the Owner's Project Requirements.

7.2.12.2 A clear, concise, and consistent procedure must be followed for each site visit to properly identify Construction Phase process problems and issues.

7.2.12.3 The site visit procedure uses statistical sampling techniques for verification of the Construction Checklists and Record Documents. This provides assurance that the verification process is not biased and has reliable consistency. The recommended procedure has the following general steps:

- (a) Identify the current state of construction to define the scope of systems and assemblies that can be verified.
- (b) Randomly select between 2% and 10% of the systems and assemblies for verification. This can be accomplished by randomly selecting a starting point and selecting every tenth item from a list or by automatically generating a random sample from a computerized database.
- (c) Identify Commissioning Team members for the site visit.
- (d) Review Owner's Project Requirements.
- (e) Accomplish verification. This task is completed by going to the selected system or assembly and comparing the installation to the completed (full or partial) Construction Checklists. Any negative responses should be reviewed in detail.
- (f) Any consistent problems with the installation identified (typically more than 10% of the sample has the same issue), including Record Documents, are documented in general terms and provided to the contractor for resolution. The contractor is then responsible for 100% checking of all affected systems or assemblies and making corrections as required.
- (g) Any inconsistent problems (one or two occurrences) are sent to the contractor, detailing the specific component, system, or assembly for resolution.

- (h) Meet with contractors to discuss any issues identified and the general progress of the project.
- (i) Meet with the Owner's representative to review the findings, project schedule, and outstanding issues.
- (j) Develop a site visit report and distribute to the Commissioning Team members and other interested parties.
- (k) Update the Issues Log.

7.2.13 Test Execution

7.2.13.1 During test execution there can be witnessing of tests, verification of tests, or verification of test data reports. Typically, only one of these is performed by the Commissioning Authority for a specific test or series of tests. However, depending upon the type and complexity of the test, it is possible in some cases to witness a portion of the test, verify the test through a random sampling of components, and verify the test data report through random sampling of the reported results.

7.2.13.2 Completion of tests should comply with the following:

- (a) Tests shall be performed according to approved written procedures. Results of test performance shall be recorded on the test data forms and witnessed.
- (b) Deviations from the approved procedures, if permitted, should be documented in writing.
- (c) Test data should be recorded under steady-state and stable conditions.
- (d) If an issue is observed during a test, the test should be terminated, within the scope of the contract. An issue report is created at the time of observation. If the issue cannot be resolved within a reasonable time period, it may be required to run the test immediately, with the understood options to run the test later, after all issues are resolved.
- (e) If an issue is discovered during review of the data, the issues shall be resolved or the test repeated in its entirety.
- (f) Upon completion of the test, the technician performing the test and the witnesses sign the test data record, attesting to the verity of the recorded observations.

7.2.13.3 Generally, the sequence of testing will be executed in the order of activities listed:

- (a) The verification of the Construction Checklists begins with equipment or assembly delivery and continues through start-up and testing.
- (b) Tests verifying system and intersystem performance according to the Owner's Project Requirements cannot begin until the Construction Checklists have been verified and accepted by the Commissioning Team.
- (c) Other sequencing requirements, depending upon the specific system, may be required to ensure the proper conditions are present or can be created.
- (d) A specified test is run according to Contract Documents or to manufacturer's requirements.

7.2.14 Verify Training

7.2.14.1 Within a reasonable period (such as three weeks) of each training program, between 5% and 10% of the

trainees shall be randomly selected and tested or informally evaluated on the material covered in the specific program. The intent of this testing is to verify that the trainees were provided with the pertinent information to operate and maintain the facility according to the Owner's Project Requirements.

7.2.14.2 It is not typically expected that the trainees will have memorized everything from the training session but that they know where the information is, can find it, and understand sufficiently to walk through the key steps to troubleshoot a problem and resolve it.

7.2.14.3 Attendee sign-in sheets should be used to verify that training was delivered to the intended people.

7.2.15 Construction Phase Commissioning Process Report

7.2.15.1 The Construction Phase Commissioning Process Report is the documentation of the commissioning work and results accomplished during the Construction Phase. The Construction Phase Commissioning Process Report contains the following:

- (a) Identification of any systems or assemblies that do not perform in accordance with the Owner's Project Requirements. For various reasons, the Owner may choose to accept performance that is at variance with the Owner's Project Requirements, either permanently or until schedule and budget constraints allow for correction. The Owner's acceptance of these conditions should be documented along with the environmental, health, safety, comfort, energy, and operating and maintenance cost impacts. The Owner's Project Requirements must be updated to match the revised expectations.
- (b) Evaluations of the operating condition of the systems at the time of test completion.
- (c) Construction Checklist completion and verification summary.
- (d) Results from the Issues Log, including the descriptions of issues and the measures taken to correct them. The description should assess the importance of the issues and estimate the value of their correction in terms of environmental impact, improved health, safety, comfort, energy consumption, operating and maintenance costs, and the ability of the facility to support its mission.
- (e) Test procedures and data. This section should incorporate the original test procedures and signed data forms, including additional data such as photos, computerized documentation, and other records of the tests. Data should include the final accepted test, as well as earlier tests that failed to meet the specified criteria. This section should also include a set of blank data forms for future use in the Continuous Commissioning Process and Re-commissioning.
- (f) Commissioning Process Progress Reports. Copies of progress reports generated throughout the Commissioning Process.
- (g) Deferred Tests. Execution of some tests may be deferred until appropriate natural loads, such as occupancy or design weather conditions, are available. For these deferred tests, the prerequisite conditions and an estimated schedule for their completion should be included.

- (h) Lessons Learned. Evaluation of the Commissioning Process used and changes that will improve the delivered project and form the basis for the Final Commissioning Process Report developed during the Occupancy and Operations Phase. This is essential to ensure that issues, benefits, and recommendations are captured in a written document while all team members are available and information is fresh.

7.2.15.2 A draft Construction Phase Commissioning Process Report should be submitted for Owner review. Submittal of the draft Commissioning Process Report to other Commissioning Team members may also be appropriate.

7.2.15.3 The final Construction Phase Commissioning Process Report should incorporate review comments from the Owner and, optionally, from other Commissioning Team members.

7.2.16 Verify Systems Manual Update

7.2.16.1 Verify that the Systems Manual is updated to incorporate materials generated during the Construction Phase. Materials that should be added are:

- (a) Test procedures and test data records.
- (b) Training plans.
- (c) Training records.
- (d) Record Drawings.
- (e) Submittal review reports.
- (f) Updated Owner's Project Requirements.
- (g) Updated Basis of Design.
- (h) Updated Commissioning Plan.
- (i) Updated Issues Log.
- (j) Commissioning Process Progress Reports.

7.2.17 Verify Update of the Basis of Design

7.2.17.1 Verify that the Basis of Design is updated to reflect any changes to the design during the Construction Phase. Verify that design changes comply with the Owner's Project Requirements. If necessary, update the Owner's Project Requirements.

7.3 Construction Phase Acceptance Requirements

7.3.1 The Commissioning Process should include the formal acceptance by the Owner of the Systems Manual, verified test reports, and training reports, consistent with the recommendations of the Commissioning Authority and appropriate other Commissioning Team members.

7.4 Construction Phase Documentation Requirements

7.4.1 The primary Commissioning Process requirements for documentation during the Construction Phase include the Construction Phase Commissioning Process Report and commissioning elements of the Systems Manual.

7.4.2 The information in these deliverables is used throughout the Occupancy and Operations Phase.

7.5 Construction Phase Training Requirements

7.5.1 The Commissioning Process training requirements for the Construction Phase are discussed in Section 7.2.14.

8. OCCUPANCY AND OPERATIONS PHASE

8.1 Introduction

8.1.1 The Occupancy and Operations Phase of the Commissioning Process begins at substantial completion. As a minimum, the Commissioning Process activities begun at this point should continue through the end of the contractual warranty/correction period and ideally continue throughout the life of the facility. During the Occupancy and Operations Phase, the ongoing operation, maintenance, and modification of the facility systems and assemblies, and their associated documentation, are verified against the updated Owner's Project Requirements.

8.1.2 The active involvement of the Commissioning Authority and Commissioning Team during the initial portion of the Occupancy and Operations Phase of a project is an integral aspect of the Commissioning Process.

8.1.3 Occupancy and Operations Phase Commissioning Process objectives include the following:

- (a) Using the Commissioning Authority's project knowledge and experience to minimize contractor callbacks.
- (b) Providing ongoing guidance on operations and maintenance to achieve the Owner's Project Requirements.
- (c) Completing seasonal testing of facility systems and assemblies.
- (d) Documenting lessons learned from applying the Commissioning Process for application to the next project.
- (e) Acceptance of Occupancy and Operations Phase Commissioning Process activities.

8.1.4 Occupancy and Operations Phase Commissioning Process activities described in this section that are to be performed by the design team and special consultants that must be included in the scope of services described in the "Owner – Design Professional Service Agreement." These Commissioning Process activities may be more than are normally required in their scope of services. The scope of services in the "Owner - Design Professional Service Agreement" should also include the requirement to cooperate with the Commissioning Authority during Pre-Design, Design, and Construction Phases of the project. This may include training, seasonal tests, problem resolution, design evaluation, site visits, updating drawings and specifications, or other requirements performed during the occupancy and initial operations period defined for the project.

8.1.5 If the Owner adopts the Commissioning Process on a project at the Occupancy and Operations Phase, then this process is termed "Retro-Commissioning" and, while it accomplishes some Commissioning Process Activities described herein, it is sufficiently different from the Commissioning Process that it is not within the scope of this guideline.

8.1.6 It is often desirable for the Owner to maintain the benefits of the Commissioning Process well into the life of the facility.

8.2 Occupancy and Operations Phase Commissioning Process Activities

8.2.1 Occupancy and Operations Phase Commissioning Process Responsibilities

8.2.1.1 During the Occupancy and Operations Phase, the Commissioning Team works to verify the ongoing compliance with the Owner's Project Requirements.

8.2.1.2 Essential team members during the Occupancy and Operations Phase include Owner's representatives, the Commissioning Authority, design professionals, contractors, and construction/program/project managers.

8.2.1.3 Responsibilities of the Commissioning Team during the Occupancy and Operations Phase include the following:

- (a) Coordinate contractor callbacks.
- (b) Verify seasonal testing of facility systems and assemblies.
- (c) Verify continuing operation and maintenance personnel training.
- (d) Verify system and assembly operations meet updated Owner's Project Requirements.
- (e) Verify continual updating of the Systems Manual.
- (f) Conduct and verify periodic performance evaluations of facility systems and assemblies.
- (g) Convene lessons-learned workshop.
- (h) Complete the final Commissioning Process Report for the project.

8.2.2 The Commissioning Authority should aid in the coordination of the callback of contractors during the Occupancy and Operations Phase. Since the Commissioning Authority has been involved since the Pre-Design Phase, he/she has the ability to identify which contractors should be contacted to resolve an issue.

8.2.3 Verification of the performance of all systems and assemblies being commissioned should be completed during the Construction Phase. However, certain weather conditions, load conditions, or occupant interactions are required to complete some verification activities. Such deferred performance verification shall be conducted at an appropriate time, and under appropriate conditions, as early as possible after occupancy.

8.2.4 Training of the Owner's operation and maintenance personnel on the fundamentals of facility and system/assembly operations and the occupants on facility usage will ideally occur primarily during the Construction Phase of a project. Some training, however, is likely to be best deferred until the Owner has assumed responsibility for his/her facility. Such training will be defined in the Commissioning Plan and Contract Documents.

8.2.4.1 Ongoing training is an integral part of a Continuous Commissioning Process. The Owner's operation and maintenance personnel and the occupants will be critical members of the Commissioning Team responsible for these periodic efforts.

8.2.5 The final project Commissioning Process Report will be completed during this phase. The requirements for a successful Commissioning Process Report are described in Section 7. Content not available or incomplete at the end of the Construction Phase will be added during this phase.

8.2.5.1 Should the Owner choose to implement the Continuous Commissioning Process for his/her facility, periodic Commissioning Process Reports will be created throughout the Occupancy and Operations Phase to reflect the Commissioning Process activities undertaken.

8.2.6 The final project Systems Manual will be completed during this phase. The requirements for a successful Systems Manual are described in Section 7. Content not available or incomplete at the end of the Construction Phase will be added during this phase.

8.2.6.1 The Systems Manual needs to be updated as changes are made to the facility throughout the entire Occupancy and Operations Phase. This includes updating the Owner's Project Requirements to reflect current conditions and needs and updating the Basis of Design to reflect changes to systems and assemblies.

8.2.7 Dynamic systems and equipment, as well as static systems, assemblies, and components, will tend to migrate from their as-installed conditions over time. In addition, the needs and demands of facility users and processes typically change as a facility is used. To attain optimal performance of facility systems, periodic verification of system, assembly, and component condition and operation is essential. The Systems Manual provides the tools and documented benchmarks for evaluation of ongoing performance. Such periodic verification is often best done in the context of a Continuous Commissioning Process.

8.2.8 The Continuous Commissioning Process has the following key activities:

- (a) Maintaining the Owner's Project Requirements to reflect changes in use and operation of the facility.
- (b) Maintaining the Basis of Design to reflect changes in systems and assemblies due to renovations or in response to changes in the Owner's Project Requirements.
- (c) Periodic evaluation of achieving the current Owner's Project Requirements and against previous benchmarks by appropriate tests.
- (d) Maintaining the Systems Manual to reflect changes in Owner's Project Requirements, Basis of Design, and systems/assemblies.
- (e) Ongoing training of operations and maintenance personnel and occupants on current Owner's Project Requirements and Basis of Design and changes in systems and assemblies.

8.3 Occupancy and Operations Phase Acceptance Requirements

8.3.1 The Commissioning Process should include the formal acceptance by the Commissioning Authority and the Owner of any deferred training, the final project Systems Manual, and the Final Commissioning Process Report during the Occupancy and Operations Phase.

8.4 Occupancy and Operations Phase Documentation Requirements

8.4.1 The final project Commissioning Process Report and final project Systems Manual are the primary documen-

tation requirements for the Occupancy and Operations Phase Commissioning Process. The information in these deliverables is used throughout the life of the facility.

8.4.2 If periodic performance verification is conducted for the Owner, a Continuous Commissioning Process Report and updates (as necessary) to training and the Systems Manual should be provided as deliverables.

8.5 Occupancy and Operations Phase Training Requirements

8.5.1 The Commissioning Process training requirements for the Occupancy and Operations Phase are discussed in Section 8.2.4.

9. REFERENCES

1. DeVor, R., T. Chang, and J. Sutherland. 1992. *Statistical Quality Control: Contemporary Concepts and Methods*, Macmillan Publishing Company, New York, Chapter 7.
2. Gitlow, H. and S. Gitlow. 1987. *The Deming Guide to Quality and Competitive Position*, Prentice-Hall, Englewood Cliffs, NJ, Chapter 3.
3. Juran, J.M. (Ed.). 1995. *A History of Managing for Quality: The Evolution, Trends, and Future Directions of Managing for Quality*, ASQC Quality Press, Milwaukee, WI.

(This is a normative annex and is part of this guideline.)

NORMATIVE ANNEX A GUIDE FOR DEVELOPING SUPPLEMENTARY TECHNICAL GUIDELINES FOR THE COMMISSIONING PROCESS

The purpose of this annex is to provide the recommended format and content for Total Building Commissioning Process supporting technical guidelines. The objective is to use the same format for all Commissioning Process guidelines. The National Institute of Building Sciences is facilitating the development of a number of technical topic guidelines to support the effective implementation of the Total Building Commissioning Process. These guidelines will be developed by various professional, technical, and trade organizations. For example, the technical guideline for heating, ventilating, air-conditioning, and refrigeration (HVAC&R) will be developed by ASHRAE. The technical guidelines are developed to assist the Commissioning Team in successfully using the Commissioning Process for various systems and assemblies. The goal is to use the process as defined and provided in Guideline 0, "The Commissioning Process." Further, it is desired that each different system or assembly involved in the construction, addition to, or rehab of buildings, structures, campuses, or utilities use the Commissioning Process from Guideline 0-2005 and not redefine it within the respective (topic) technical guideline.

The objective of both Guideline 0-2005 and the technical guidelines is to provide information on implementing the Commissioning Process. The technical guidelines are not intended to be a detailed user's guide or provide guide speci-

fications, full commissioning plans, development of owner's project requirements, construction checklists, statistical or other quality tools, or other detailed requirements for implementing the Commissioning Process.

The format of the technical guidelines should follow the same format used in Guideline 0-2005. The following is the general organization to be used in the development of the technical guidelines.

FOREWORD

The Foreword should provide key information on what has led to success on previous projects, the role of the specific technology in a successful building or construction project, and closely related supplementary technical guidelines or topics.

SECTION 1, PURPOSE

The following should be used as the general purpose for each technical guideline:

"The purpose of this guideline is to describe the technical requirements for the application of the Commissioning Process described in ASHRAE Guideline 0-2005 that will verify that the [*insert topic, for example, fire systems or envelope assembly*] achieves the Owner's Project Requirements."

SECTION 2, SCOPE

The following text should be used as the general scope for each technical guideline:

"The procedures, methods, and documentation requirements in this guideline describe the application of the Commissioning Process for each project delivery phase from Pre-design through Owner Occupancy and Operation for [*insert topic*] to support the Commissioning Process activities described in ASHRAE *Guideline 0-2005, The Commissioning Process* (also published by NIBS as Guideline 0, *The Total Building Commissioning Process*). This includes requirements for:

- (a) [*insert topic*] to fully support the Total Building Commissioning Process activities,
- (b) verification during each phase of the Commissioning Process,
- (c) acceptance at each phase,
- (d) documentation during each phase,
- (e) Systems Manual, and
- (f) training for operations and maintenance personnel and occupants."

SECTION 3, UTILIZATION

The following paragraphs should be included as the Utilization section:

3.1 The application of this guideline will depend upon the Owner's Project Requirements and how the project will be designed, built, and operated. This guideline is supplemental to the Commissioning Process detailed in ASHRAE Guideline 0-2005.

3.2 This guideline describes specific details required to properly implement the Commissioning Process relative to

[insert topic]. This includes documentation, test procedures, and checklists.

SECTION 4, DEFINITIONS

Include definitions that are unique to the technical guideline. Do not redefine or repeat those in ASHRAE Guideline 0; instead, include a statement referring to the definitions in Section 4 of Guideline 0.

SECTION 5, PRE-DESIGN PHASE

The following needs to be included in the Pre-Design Phase section for [insert topic]:

1. List of Commissioning Team members.
2. List and description of criteria and items to be included in the Owner's Project Requirements document.
3. List of milestones.
4. List of specialists required for implementing the Commissioning Process.
5. List of items to focus upon during the design reviews.
6. List of items to be included in the Commissioning Plan.
7. List of items to be included as part of the Issues Log.
8. List of items required for acceptance of Pre-Design Phase commissioning.
9. Develop needs for tests and list tests that need to be performed.
10. Develop training requirements.
11. Develop requirements for the Systems Manual, such as parts lists, troubleshooting needs, operations and maintenance requirements, system description, level at which each set of material needs to be written for clear understanding.

SECTION 6, DESIGN PHASE

The following needs to be included in the Design Phase section for (topic). This will be the basis for Construction Phase documents for contractors, vendors, and equipment/assembly manufacturers:

1. List of items required for the Basis of Design.
2. Revision review procedure for Commissioning Team members and Owner's Project Requirements.
3. List of coordination requirements and items provided by others.
4. Key milestones that need to be reviewed.
5. Update lists of specialists required to implement the Commissioning Process based upon the actual design and interrelationship with other systems and assemblies.
6. List of items to be included in the construction documents.
7. Develop lists of priority items and relate whenever possible to safety, health, energy, environmental impact, aesthetics, operations and maintenance, in addition to Owner's Project Requirements.
8. List of Construction Checklists to be used by the contractor.

9. Samples of Construction Checklists. Examples of construction checklists are included in Annex M to this guideline and in other annexes in other supplementary technical guidelines (such as ASHRAE Guideline 1-200x, HVAC&R Technical Requirements for the Commissioning Process).
10. List of items to be included in the Systems Manual, such as parts lists, troubleshooting needs, operations and maintenance requirements, system description, level at which each set of material needs to be written for clear understanding.
11. List of training requirements, timing, learning outcomes.
12. Develop needs for tests and tests that need to be performed.
13. List of items required for acceptance of Design Phase commissioning.

SECTION 7, CONSTRUCTION PHASE

The following needs to be included in the Construction Phase section for [insert topic]:

1. List of test procedures and data forms to verify achievement of Owner's Project Requirements and Basis of Design.
2. Samples of test procedures and data forms. Examples of these are included in Annex U to other supplementary technical guidelines (such as ASHRAE Guideline 1-200X, HVAC&R Technical Requirements for the Commissioning Process).
3. List of coordination requirements and items provided by others.
4. List of specific items for the site visit procedures.
5. Tests needs and schedule.
6. Commissioning Team meetings.
7. Issues Logs.
8. Input into the final Commissioning Process Report.
9. Lessons-learned workshop schedule during Occupancy and Operations Phase.
10. List of items required for acceptance of Construction Phase commissioning.

SECTION 8, OCCUPANCY AND OPERATIONS PHASE

The following needs to be included in the Occupancy and Operations Phase section for [insert topic]:

1. List of training items to be accomplished during the first year of operation.
2. List of warranty items to be checked during the first year of operation.
3. List test requirements during occupancy, including periodic re-testing for a successful continuous operation of the facility.
4. List who should attend the lessons-learned workshop.
5. List of criteria to be included in the final Commissioning Process Report.
6. List of items required for acceptance of Occupancy and Operations Phase commissioning.

SECTION 9, REFERENCES

Include industry-specific references that support recommendations for benchmarking, testing, and other supporting guidance in the development of the Owner's Project Requirements, Basis of Design, tests, and other Commissioning Process documents.

ANNEXES

Annexes are to be used to provide additional information, examples of documentation, examples of specifications, acceptance procedure details, and other items that are not required to achieve compliance with the technical guideline but will assist in implementing the Commissioning Process for the specific technical system or assembly. This is the place to illustrate best practices and to provide information on how to achieve best practice and economy in design. Annex Q, References, should provide current articles, guides, and other information on implementing the Commissioning Process for the specific supporting technical requirements guidelines.

The desired goal is to have all Commissioning Process guidelines use the same annex designation. They should use the same annex letters as Guideline 0-2005. If an annex is not required, it should specifically be so noted in each technical guideline—suggested wording: “This annex is intentionally left blank” or “There is no supplemental information required for [insert assembly or system] technology.” Annex A will be empty in all supplemental guidelines. Annex B is specific to Guideline 0 and should not be changed in supplemental guidelines. Annexes C through E may require no modification for most supplemental guidelines.

NOTE: The list and numbering of annexes, to be in compliance with Guideline 0-2005, must be as follows:

- Annex A – Guide for Developing Supplementary Technical Guidelines for the Commissioning Process (used only in Guideline 0)
- Annex B – Commissioning Process Flowchart (used only in Guideline 0)
- Annex C – Cost and Benefits of the Commissioning Process (typically only in Guideline 0)
- Annex D – Commissioning Process Documentation Matrix (typically only in Guideline 0)
- Annex E – Commissioning Process Request for Qualifications (typically only in Guideline 0)
- Annex F – Roles and Responsibilities
- Annex G – Commissioning Plan
- Annex H – Acceptance Plan
- Annex I – Owner's Project Requirements Workshop Guidance
- Annex J – Owner's Project Requirements
- Annex K – Basis of Design
- Annex L – Specifications
- Annex M – Construction Checklists
- Annex N – Quality-Based Sampling Examples
- Annex O – Systems Manual
- Annex P – Training Manual and Training Needs
- Annexes Q through X – In addition to the annexes (above) that are included in Guideline 0-2005, *The*

Commissioning Process, all supplemental technical guidelines should include the following annexes with specific technical topic guidance or requirements, as appropriate. It is the intent to have all technical guidelines use the same reference letter for each topic. That is, all examples of Checklists would always be included in Annex M. The technical Commissioning Process guidelines should include annexes that provide examples and guidance on the following topics or should include notes such as “Not used,” or “This annex is intentionally left blank,” or “There is no supplemental information required.”

- Annex Q – Publications, Articles, References, Codes, Regulations, and Standards
- Annex R – Integration Requirements
- Annex S – Interference and Coordination with Other Systems and Assemblies
- Annex T – Communications: What, When, and Who
- Annex U – Test Procedures and Data Forms
- Annex V – Pre-Design Phase Commissioning Process Specific Needs
- Annex W – Design Phase Commissioning Process Specific Needs
- Annex X – Construction Phase Commissioning Process Specific Needs
- Annex Y – Occupancy and Operations Phase Commissioning Process Specific Needs
- Annex Z (and, if needed, Annex AA and beyond) can be used as required for other topics that are determined to be useful for a specific assembly or system.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX B COMMISSIONING PROCESS FLOW CHART

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

The flow chart shown in Figure B.1 depicts an example for an owner who has adopted the Commissioning Process from project inception. If the owner adopts the Commissioning Process after project inception, then the tasks shown are still accomplished in whatever phase the Commissioning Process commences. The Continuous Commissioning Process is shown in the flow chart as ongoing tasks during the Occupancy and Operations Phase after the last acceptance block.

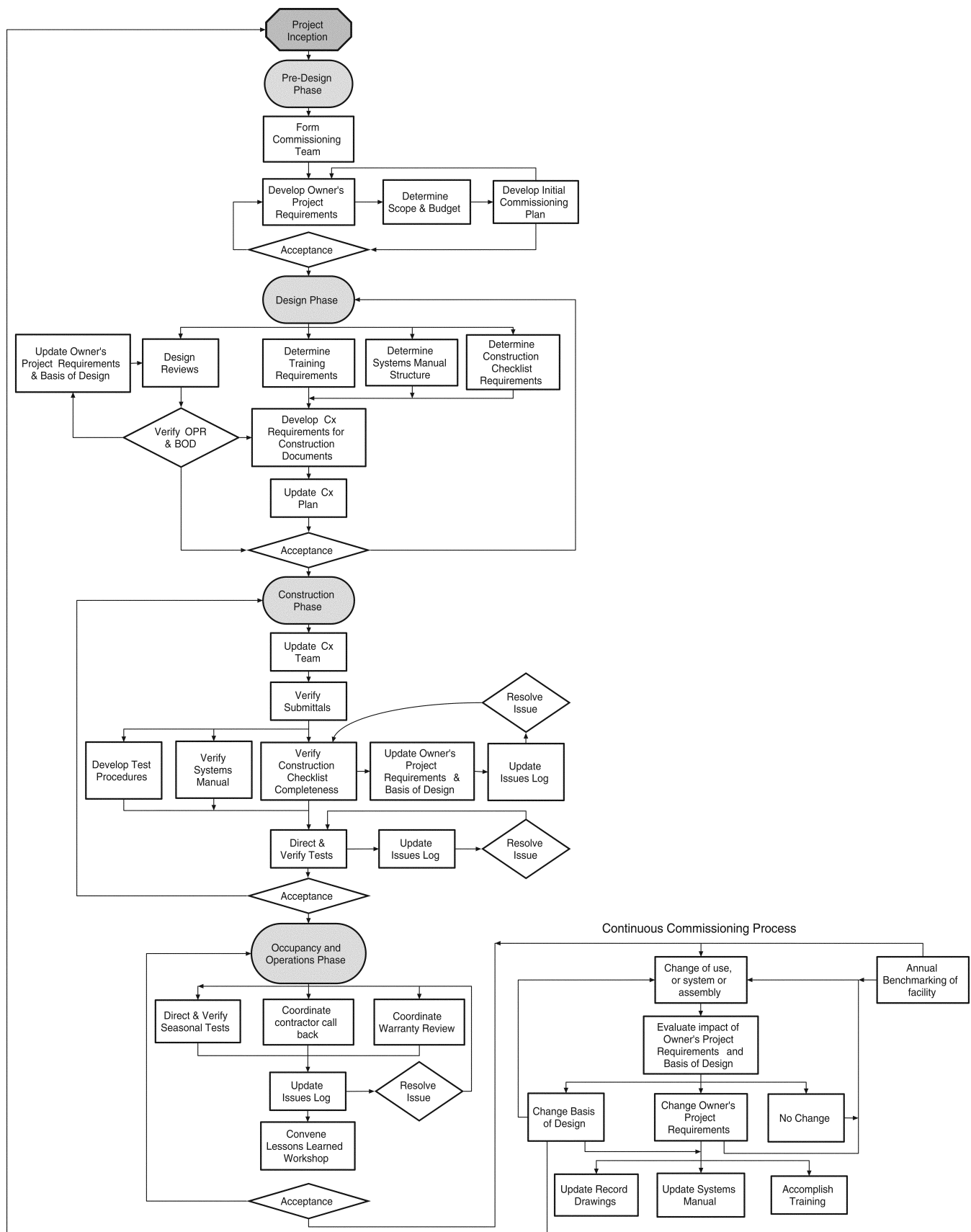


Figure B.1 Commissioning process flow chart.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX C

COST AND BENEFITS OF THE COMMISSIONING PROCESS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

OVERVIEW

The Commissioning Process focuses on producing a quality-based system that achieves the Owner's Project Requirements.

This annex discusses the potential benefits and where they accrue and quantifies these benefits by providing evidence of potential costs and savings.

DISCUSSION OF NEW COST ITEMS

Ultimately, the owner of the facility will determine the extent of the Commissioning Process activities and who will be responsible for each phase of work. The intent here is to outline the scope of work that represents new cost items rather than to assign responsibilities for each task. The cost of the Commissioning Process should be considered as a part of the project budget.

Design Professional

In addition to the design professional's typical scope of work, including the preparation of design drawings and specifications, the Commissioning Process often requires that the design professional work with the Commissioning Authority to integrate the Commissioning Process activities into the project specifications. These activities typically include:

1. Test requirements and documentation.
2. Operational, maintenance, and troubleshooting documentation requirements.
3. Construction Checklists.
4. Systems Manual.
5. Comprehensive training program for operation and maintenance personnel and users.

The design professional may also be responsible for reviewing the Commissioning Plan at the various phases of the process and for delivering the Basis of Design in a format specific for the owner.

Commissioning Authority

The activities accomplished by the Commissioning Authority as defined in this guideline require that additional funds be allocated during the Pre-Design, Design, and Construction Phases. These funds are allocated from the savings obtained through fewer change orders and requests for information and through reduced problems during start-up of the systems and occupancy of the facility.

Contractors

The completion of some detailed tests is unique to the Commissioning Process. The contractor will have additional work and costs associated with completing these tests.

DISCUSSION OF BENEFITS

For convenience and clarity, benefits will be discussed as they relate to major participants in the Commissioning Process: the Design Professional, the Contractor, and the Owner.

Benefits to the Design Professional

Potential benefits include:

- Facility will achieve the of Owner's Project Requirements.
- Reduced risk exposure.
- Improved knowledge base for use in future designs and installation.
- Benefit of other participants' input, leading to the most cost-effective design and operation.
- Reduced number of interference drawings during construction due to improved communication and coordination throughout the project.

Benefits to the Contractor

Potential benefits include:

- Improved planning and coordination through the implementation of the Commissioning Plan.
- Improved coordination between different trades and reduced likelihood of site interference drawings required of contractors throughout the project. Reduced number of deficiencies at substantial completion. Reduced number of callbacks.
- Reduced number of calls for operational guidance due to participation in training programs for operations and maintenance personnel.

Benefits to the Owner

Potential benefits include:

- Improved operator knowledge of how to optimize the facility operation and maintenance due to the early inclusion of operators in the Commissioning Process.
- Reduced training requirements due to continuously updated documentation of how systems should operate and be maintained; personnel will only need to be trained with regard to changes.
- Facility performance is in accordance with the Owner's Project Requirements.
- Systems Manual provides an easy reference document for system and assembly operation and maintenance.
- Reduced downtime due to better diagnosis of failures.
- Improved ability to provide accurate information to occupants on facility operation and maintenance.
- Lower operating costs due to improved operational techniques.
- Benefits to building occupants, including greater worker productivity, reduced complaints, and reduced incidence of absenteeism.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX D COMMISSIONING PROCESS DOCUMENTATION MATRIX

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive repre-

sentation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

The following table summarizes the documents that are produced during the implementation of the Commissioning Process on a project.

TABLE D-1 Documentation Matrix

| Phase | Document | Input By | Provided By | Reviewed/ Approved By | Used By | Notes |
|--------------|---|---|-------------------|------------------------------------|-------------------------------------|---|
| Pre-Design | Owner's Project Requirements | O&M, Users, Capital Projects, Design Team (?) | CA or Designer | Owner | CA, Design Team | Design Team may not be hired yet. |
| | Commissioning Plan | Owner, Design Team (?), CA | CA | Owner | CA, Owner, Design Team | Design Team may not be hired yet. |
| | Systems Manual Outline | O&M, CA | Owner or CA | Owner | Design Team | May be included in OPR |
| | Training Requirements Outline | O&M, Users, CA, Design Team | Owner or CA | Owner | Design Team | May be included in OPR |
| | Issues Log | CA | CA | N/A | CA, Design Team | May be only format at this phase |
| | Issues Report | CA | CA | Owner | Design Team, Owner | |
| | Pre-Design Phase Commissioning Process Report | CA | CA | Owner | Owner | Close of Phase report |
| Design | Owner's Project Requirements Update | O&M, Users, Capital Projects, Design Team | CA or Designer | Owner | CA, Design Team | |
| | Basis Of Design | Design Team | Design Team | Owner, CA | Design Team, CA | |
| | Construction Specifications for Commissioning | Design Team, CA, Owner | Design Team or CA | Owner | Contractors, CA, Design Team | May also be provided by Project Manager/ Owner's Rep. |
| | Systems Manual Outline-Expanded | Design Team, CA, O&M, Contractor (?) | Design Team or CA | Owner, CA | Design Team, Contractor | Contractor may not be hired yet. |
| | Training Requirements In Specifications | O&M, Users, CA, Design Team | Owner or CA | Owner | Design Team | Contractor may not be hired yet |
| | Design Review Comments | CA | CA | Owner | Design Team | |
| | Issues Log | CA | CA | N/A | CA, Design Team | |
| | Issues Report | CA | CA | Owner | Design Team, Owner | |
| | Design Phase Commissioning Process Report | CA | CA | Owner | Owner | Close of Phase report |
| Construction | Owner's Project Requirements Update | O&M, Users, Capital Projects, Design Team | CA or Designer | Owner | CA, Design Team, Contractors | |
| | Basis of Design Update | Design Team | Design Team | CA, Owner | Design Team, CA | |
| | Commissioning Plan Update | Design Team, CA, Owner, Contractor | CA | CA, Owner, Design Team, Contractor | CA, Owner, Design Team, Contractors | |
| | Submittal Review Comments | CA | Design Team | Design Team | Contractor | |

Notes:

1. The term "contractor" is understood to refer to any of several entities that provide construction services. Depending upon the project, this could include, among others, the owner's representative, construction manager, contractors, and subcontractors.
2. Abbreviations: CA: Commissioning Authority; O&M: operations and maintenance personnel; OPR: Owner's Project Requirements.

TABLE D-1 (Continued) Documentation Matrix

| Phase | Document | Input By | Provided By | Reviewed/ Approved By | Used By | Notes |
|--------------------------|---|----------------------------------|------------------|--------------------------|-------------------------------------|-----------------------|
| | System Coordination Plans | Contractor, Design Team | Contractor | CA, Design Team | Contractor, CA | |
| | Inspection Checklists | CA, Contractor, Design Team | CA | CA, Design Team | Contractor | |
| | Inspection Reports | Contractor | CA | CA, Owner | Contractor | |
| | Test Procedures | CA, Contractor, Design Team | CA | CA, Design Team | Contractor | |
| | Test Data Reports | Contractor | CA | CA, Owner | Contractor | |
| | Commissioning Meeting Agendas and Minutes | CA | CA | All | All | |
| | Training Plans | Design Team, CA, O&M, Contractor | Contractor or CA | Owner, CA | O&M, Users, Contractor | |
| | Systems Manual | Design Team, CA, O&M, Contractor | Contractor | Owner, CA | O&M, Users | |
| | Issues Log | CA | CA | N/A | CA, Design Team, Contractor | |
| | Issues Report | CA | CA | Owner, Design Team | Design Team, Owner, Contractor | |
| | Preliminary Construction Commissioning Process Report | CA | CA | Owner | Owner | Prior to Occupancy |
| | Final Construction Phase Commissioning Process Report | CA | CA | Owner | Owner | Close of Phase report |
| Occupancy and Operations | Owner's Project Requirements Update | O&M, Users, Design Team | CA or Designer | Owner | CA, Design Team, Contractors | |
| | Basis of Design Update | Design Team | Design Team | CA, Owner | Design Team, CA | |
| | Maintenance Program | O&M, Contractor, CA | Owner or CA | Owner, CA | O&M, Users | |
| | Test Procedures | Contractor, CA, O&M, Design Team | CA | Design Team, CA | Contractor | |
| | Test Data Reports | Contractor | CA | CA, Owner | Contractor, O&M | |
| | Issues Log | CA | CA | N/A | CA, Design Team, Owner, Contractors | |
| | Issues Report | CA | CA | Owner | Design Team, Owner, Contractors | |
| | Commissioning Process Report | CA | CA | Owner | Owner | Final report |
| | Re-Commissioning Plan | O&M, Users, CA | CA or Owner | Owner | Owner | |

Notes:

1. The term "contractor" is understood to refer to any of several entities that provide construction services. Depending upon the project, this could include, among others, the owner's representative, construction manager, contractors, and subcontractors.
2. Abbreviations: CA: Commissioning Authority; O&M: operations and maintenance personnel; OPR: Owner's Project Requirements.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX E COMMISSIONING PROCESS REQUEST FOR QUALIFICATIONS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

BACKGROUND

_____ (Owner) is seeking the services of a qualified Commissioning Authority for _____. The project is a _____ gross ft², _____ story, Class _____ [type] _____ building in [city & state] _____, _____, with a project budget of \$_____ million. The facility is expected to be composed of _____% [space type], _____% [space type], and _____% [space type].

The project is currently in the early pre-design phase. The expected schedule is to start design by _____, start construction by _____, and occupy by _____.

The management structure is traditional design/bid/build with full design documents and specifications being developed by an architectural/engineering firm. The construction documents will be let out to bid and a general contractor will be hired to complete the construction. The Owner's primary construction representative on site will be provided by the separately contracted services of a construction manager. The Commissioning Authority will be hired by and report directly to the Owner.

SCOPE OF WORK

The Owner has adopted the Commissioning Process as his/her quality process to plan, design, construct, and operate this facility. As with any quality process, the Commissioning Process provides tools to enable everyone involved in the construction of the facility to verify that the final facility meets the Owner's Project Requirements.

The following is a summary of the Commissioning Process that the Owner intends to implement on this project. The proposer is free to suggest changes and improvements to this process. However, for this proposal the following process will be assumed.

Commissioning Process During the Pre-Design Phase

The Commissioning Process activities completed by the Commissioning Authority during the Pre-Design Phase include:

- Developing and documenting the Owner's Project Requirements.
- Identifying a scope and budget for the Commissioning Process.

- Developing the initial Commissioning Plan.
- Acceptance of Pre-Design Phase Commissioning Process activities.

Commissioning Process During the Design Phase

The Commissioning Process activities completed by the Commissioning Authority during the Design Phase include:

- Works with the Commissioning Team to document the Owner's Project Requirements for the facility.
- Works with the design professionals in documenting the Basis of Design.
- Verifies the Basis of Design with regard to the Owner's Project Requirements.
- Develops a Commissioning Plan encompassing the Design, Construction, Occupancy and Operations Phases.
- Determines the commissioning requirements and activities to include in the Construction Documents, with review by the design team, for integration into the project's construction specifications.
- Reviews the in-depth design documentation developed by the design professionals.
- Performs statistically based quality design review at 35%, 50%, 95%, and 100% completion of the drawings and specifications.

Commissioning Process During the Construction Phase

The Commissioning Process activities accomplished by the Commissioning Authority during the Construction Phase include:

- Organizes the Commissioning Process components and conducts a pre-bid and pre-construction meeting where the Commissioning Process requirements are reviewed with the Commissioning Team.
- Organizes and conducts periodic Commissioning Team meetings necessary to plan, develop the scope of, coordinate, and schedule activities and resolve problems.
- Reviews submittals concurrent with the design professional's review.
- Works with Contractors in completing Construction Checklists and tracking of Checklist completion.
- Statistically samples completion of Construction Checklists on a periodic basis to verify that Contractor's quality process is achieving the Owner's Project Requirements.
- Develops specific test procedures. The Contractors review the procedures.
- Directs the execution of the tests by the Contractors.
- Documents the results of the tests.
- Documents the correction and retesting of noncompliance items by the Contractor.
- Reviews the Systems Manual for achieving the Owner's Project Requirements.
- Reviews, pre-approves, and verifies the training provided by the Contractors.
- Verifies delivery of the Systems Manual.

Commissioning Process During the Occupancy and Operations Phase

The Commissioning Process activities accomplished by the Commissioning Authority during the Occupancy and Operations Phase include:

- Schedules and verifies deferred and seasonal testing by the Contractor.
- Verifies continuing training.
- Accomplishes a review of warranties with the operations and maintenance staff two months prior to expiration of warranty.
- Schedules, organizes, and attends a lessons-learned workshop. The workshop is facilitated by an independent member of the Commissioning Authority's firm.
- Completes the Final Commissioning Process Report.

LIMIT OF RESPONSIBILITIES

The Commissioning Authority is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The Commissioning Authority may assist with problem-solving or resolving nonconformance or deficiencies, but ultimately that responsibility resides with the general contractor and design professionals.

FOCUS OF THE COMMISSIONING PROCESS

The following systems and assemblies are the focus of the Commissioning Process:

- *[Insert list of systems and assemblies]*

DESIRED QUALIFICATIONS

It is desired that the person designated as the Commissioning Authority satisfy as many of the following requirements as possible:

1. Has acted as the principal Commissioning Authority for at least three projects during the past year. [Note that the size of the project should be accounted for. Whereas one proposer may have done ten projects all small in size, another proposer that accomplished one large and complex project may have equal credentials].
2. Experienced in quality processes.
3. Knowledgeable in building operation and maintenance training.
4. Excellent verbal and written communication skills. Highly organized and able to work with both management and trade contractors.
5. A bachelor's degree in *[insert discipline]* is strongly preferred and *[insert type]* certification or professional license is desired.
6. The Commissioning Authority's firm will demonstrate depth of experienced personnel and capability to sustain loss of assigned personnel without compromising quality and timeliness of performance.

7. The Commissioning Authority will be an independent contractor and not an employee or subcontractor of the General Contractor or any other subcontractor on this project, including the design professionals.
8. *[Insert any qualifications or special requirements for a specific system or assembly].*

INSTRUCTIONS TO PROPOSERS

A proposer must propose to execute all phases of the Commissioning Process in a single proposal. The proposal must be signed by an officer of your firm with the authority to commit the firm.

1. List the key individual who will be the Commissioning Authority for this contract and describe his or her relevant qualifications and experience. This information is required in addition to any detailed resumes the proposer submits. The contract will require that this individual be committed to the project for its duration.
2. Provide project and professional references and experience for three to five commissioning projects for which the proposer was the principal Commissioning Authority in the last three years. Include a description of the projects, identify when the proposer came into the projects, and describe the involvement of each individual on the proposer's team in the projects. For each project, attach a sheet that includes the name and telephone number of the Owner's project manager, construction manager, facility administrator of the building, the design professionals, and the contractors.
3. Describe any experience of the proposer's team in the following areas. List each party's involvement.
 - (a) Quality process experience.
 - (b) Operation and maintenance experience.
 - (c) Design experience.
 - (d) Life-cycle costing.
 - (e) *[Insert other system or assembly specific experience requirements].*
4. Describe your proposed approach to managing the project expertly and efficiently, including your team participation. Describe what approach you will take to integrate the Commissioning Process into the normal design and construction process in order to make it "business as usual."
5. Describe what you will do to foster teamwork and cooperation from contractors and designers and what you will do to minimize adversarial relationships.
6. Describe how your work will facilitate the use of your product as a prototype that may be subsequently used by the Owner in future projects, including access to the electronic versions of all documents and forms.
7. As an attachment, provide the following work products that members of the proposer's team wrote.
 - (a) Commissioning Plan that was executed.
 - (b) Integrated commissioning specifications.
 - (c) Electronic Issues Log.
 - (d) Construction Checklists.
 - (e) Test procedure that was executed.
8. *[Insert any other desired instructions].*

SELECTION CRITERIA

The submitted proposals will be reviewed and ranked according to the following (items from the above numbered list):

- | | |
|---|------------------|
| 1. Key individual experience | 20 points |
| 2. Staff experience | 15 points |
| 3. Similar project experience | 20 points |
| 4. Team experience in related skill areas | 15 points |
| 5. Management approach | 20 points |
| 6. Work examples | <u>10 points</u> |
| | 100 points |

Reference checks will not be scored individually but may be used to supplement all categories. The Owner reserves the right to eliminate or change the weight of extremely high or extremely low fee proposals.

SUBMISSION AND SELECTION

Consultants will submit [quantity _____] copies of the written proposal, to be received in the Owner's office at [address _____] by [date and time _____]. Late proposals will not be accepted.

Review and selection process.....

Requirement of personal interview for finalists.....

LIMITATIONS AND PROVISIONS

[Insert wording on right to reject, to seek clarifications, to negotiate a final contract; cost of proposal preparation not reimbursable; primary contact for questions; other necessary legal language, etc.]

MINIMUM REQUIREMENTS FOR CONTRACT EXECUTION

General Conditions

Miscellaneous as required.....

Insurance

The Commissioning Authority's firm shall obtain, at the firm's expense, and keep in effect during the term of the project, \$[list required insurance].

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX F ROLES AND RESPONSIBILITIES

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

Understanding and defining the role of each participant is vital to the success of the Commissioning Process. This annex provides an example of the responsibilities of each participant in a comprehensive Commissioning Process. These responsibilities shall be documented in the contracts between the owner and the contractor(s) and the owner and the design professionals. The responsibilities of each participant should be included in the contract documents.

The responsibilities of the owner, Commissioning Authority, design professionals, construction manager, contractors, and manufacturers are detailed below.

OWNER

1. Include a statement regarding design professional commissioning responsibilities and scope in the request for design services.
2. Develop and commit to the Owner's Project Requirements for the facility and its use.
3. Assign operations and maintenance personnel and schedule them to participate in the various meetings, training sessions, and observations/inspections as follows:
 - (a) Design Phase coordination meetings.
 - (b) Construction Phase coordination meetings.
 - (c) Initial owner-training session at initial placement of major equipment.
 - (d) Maintenance orientation and inspection.
 - (e) System testing verification meetings.
 - (f) Procedures meeting for testing systems.
 - (g) Owner's training session.
 - (h) Verification demonstrations.
 - (i) Systems and assemblies tests.
 - (j) Final review at acceptance meeting.
4. Review and approve any changes made to Owner's Project Requirements.
5. Review and approve the Construction Documents.
6. Provide qualified personnel for videotaping and editing of training sessions.
7. Videotape construction progress.
8. Review and comment on the Commissioning Authority's Commissioning Process Progress Reports.
9. Review and comment on the Commissioning Authority's verification reports.
10. Review and accept the Commissioning Authority's Commissioning Process Report.

COMMISSIONING AUTHORITY

1. Organize and lead the Commissioning Team.
2. Facilitate and document the Owner's Project Requirements.
3. Verify that the Commissioning Process activities are clearly stated in all scopes of work.
4. Integrate the Commissioning Process activities into the project schedule.

5. Prepare a Commissioning Plan that describes the extent of the Commissioning Process to accomplish the Owner's Project Requirements. Update the Commissioning Plan during each phase of the project to incorporate changes and additional information.
6. Review and comment on the ability of the design documents to achieve the Owner's Project Requirements for the commissioned systems and assemblies.
7. Prepare the Commissioning Process activities to be included as part of the project specification. Include a list of all individual trade contractor responsibilities for all the Commissioning Process activities (list contractors by name, firm, and trade specialty if known).
8. Execute the Commissioning Process through the writing and review of Commissioning Process Reports, organization of all Commissioning Team meetings, tests, demonstrations, and training events described in the Contract Documents and approved Commissioning Plan. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities, and timely notification to participants for each Commissioning Process activity. The Commissioning Authority shall act as chair at all commissioning events and ensure execution of all agenda items. The Commissioning Authority shall prepare minutes of every Commissioning Process activity and send copies to all Commissioning Team members and attendees within five workdays of the event.
9. Review the plans and specifications (during the Pre-Design and Design Phases) with respect to their completeness in all areas relating to the Commissioning Process. This includes verifying that the Owner's Project Requirements have been achieved, and that there are adequate devices included in the design to properly test the systems and assemblies and to document the performance of each piece of equipment, system, or assembly.
10. Schedule all document review coordination meetings.
11. Attend the project's pre-bid meeting to detail the design professional or contractor Commissioning Process requirements.
12. Schedule the pre-design and pre-construction Commissioning Process meeting within 60 days of the award of the contract at some convenient location and at a time suitable to the attendees. This meeting will be for the purpose of reviewing the complete Commissioning Process and establishing tentative schedules for the Design Phase and Construction Phase commissioning activities.
13. Develop the initial format to be used for Issues Logs throughout and for each phase of the Commissioning Process.
14. Schedule the initial owner training session so that it will be held immediately before the contractor training. This session will be attended by the owner's O&M personnel, the design professionals, the contractor, and the Commissioning Authority. The Commissioning Authority will review the Owner's Project Requirements and the design professional(s) will review the Basis of Design.
15. Review proposed contractor-provided training program to verify that the Owner's Project Requirements are achieved.
16. Attend a portion of the contractor-provided training sessions to verify that the Owner's Project Requirements are achieved.
17. Receive and review the Systems Manual as submitted by the contractor. Verify that it achieves the Owner's Project Requirements. Insert systems descriptions as provided by the design professional(s) in the Systems Manual.
18. Witness system and assembly testing. Verify the results and include a summary of deficiencies.
19. Supervise the Commissioning Team members in completion of tests. The test data will be part of the Commissioning Process Report.
20. Periodically review Record Drawings for accuracy with respect to the installed systems. Request revisions to achieve accuracy.
21. Verify that the Systems Manual and all other design and construction records have been updated to include all modifications made during the Construction Phase.
22. Repeat implementing of tests to accommodate seasonal tests or to correct any performance deficiencies. Revise and resubmit the Commissioning Process Report.
23. Prepare the final Commissioning Process Report.
24. Assemble the final documentation, which includes the Commissioning Process Report, the Systems Manual, and all record documents. Submit this documentation to the owner for review and acceptance.
25. Recommend acceptance of the individual systems and assemblies to the owner (in accord with the defined project requirements).

DESIGN PROFESSIONAL

1. Participate and assist in the documentation of the initial Owner's Project Requirements.
2. Document revisions to the Owner's Project Requirements and obtain approval from the owner.
3. Document the Basis of Design
4. Prepare Contract Documents, including the integration of the Commissioning Process requirements and activities provided by the Commissioning Authority.
5. Prepare Contract Documents that coordinate required interfaces between systems and assemblies.
6. Attend the Pre-Design and Design Phase coordination and review meetings.
7. Respond to Commissioning Team design submission review comments and other issues in a timely manner.
8. Attend the pre-bid and pre-construction meetings as scheduled by the Commissioning Authority.
9. Specify and verify that the operation and maintenance of the systems and assemblies has been adequately detailed in the Construction Documents.
10. Review and incorporate as appropriate the Commissioning Authority's comments from submittal reviews.

11. Participate in the initial operation and maintenance personnel and occupant training session by presenting the project Basis of Design.
12. Participate in other training as detailed in the training program.
13. Review test procedures submitted by the contractor.
14. Review and comment on the Commissioning Authority's periodic Commissioning Process Progress Reports and Issues Log reports.
15. Review and accept record documents as required by Contract Documents.
16. Review and comment on the final Commissioning Process Report.
17. Recommend final acceptance of the systems to the owner.

CONSTRUCTION MANAGER

1. Include costs for Commissioning Process activities in the contract price.
2. Include Commissioning Process requirements and activities in all contractors' contracts.
3. Provide adequate accessibility as required to properly operate and maintain the facility.
4. Provide acceptable representation with the means and authority to prepare and coordinate implementation of the Commissioning Process as detailed in the Contract Documents.
5. Issue a statement certifying that all work has been completed and that the facility is operational, in accordance with Contract Documents.
6. Issue the appropriate final reports to the design professionals for review and acceptance.
7. Remedy deficiencies identified by the Commissioning Authority during verification of the installation or testing.
8. Review and comment on the final Commissioning Process Report.

CONTRACTOR

1. Include costs for Commissioning Process activities in the contract price.
2. Include Commissioning Process requirements and activities in each purchase order or subcontract written.
3. Obtain cooperation and participation of all subcontractors and manufacturers.
4. Attend the pre-construction and Commissioning Team meetings.
5. Include Commissioning Process milestones in the project schedule.
6. Implement the training program as detailed in the Contract Documents.
7. Provide submittals to the owner, design professionals, and the Commissioning Authority.
8. Notify the Commissioning Authority when systems and assemblies are ready for testing.

9. Demonstrate the performance of assemblies and/or operation of systems to the Commissioning Authority.
10. Complete the Construction Checklists as the work is accomplished. Provide the completed Construction Checklists to the Commissioning Authority.
11. Continuously maintain the Record Drawings and submit as detailed in the Contract Documents.

MANUFACTURERS

1. Provide all information required for the operation and maintenance of the system or assembly as part of the initial submittal.
2. Provide the requirements to maintain the warranty as part of the initial submittal.
3. Coordinate and accomplish factory tests as detailed in the Contract Documents.
4. Provide training as detailed in the training program contained in the Contract Documents.
5. Demonstrate operation and performance of the system or assembly as detailed in the Contract Documents.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX G COMMISSIONING PLAN

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

The following is an example outline for a Commissioning Plan. The basic structure of this example is such that each phase of the plan has its own section detailing what activities will be accomplished and guidance on who accomplishes them and how they are completed. The results from each activity are then included in an appendix. The intent of this format is for the Commissioning Plan to become the Final Commissioning Process Report at the end of the project by filling in the results as the project progresses.

Depending upon the size and scope of the Commissioning Process activities, it may be beneficial to have three Commissioning Plans: one for the Pre-Design Phase, one for the Design Phase, and one for the Construction Phase. If separate Commissioning Plans are used, then care must be taken to inform those that are involved in only a portion of the process of the previous material.

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(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX H ACCEPTANCE PLAN

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

Developing and documenting the acceptance procedures in an acceptance plan is an important task for the successful implementation of the Commissioning Process. The acceptance plan details the key Commissioning Process activities that must be accomplished at the end of each phase in a project in order to move on to the next phase.

The following provides a description of the details that should be included in the acceptance plan and demonstrates a format that could be used.

PRE-DESIGN PHASE

The Owner's Project Requirements and the Commissioning Plan are formally accepted by the Owner during the Pre-Design Phase, after review and comment by the Commissioning Authority. The general process for accepting these documents is:

1. The Commissioning Authority develops a draft of each document and provides it to the Commissioning Team.
2. The Commissioning Team provides comments on the draft documents.
3. The Commissioning Authority works with the Commissioning Team to resolve any issues.
4. The Commissioning Authority recommends acceptance of the documents to the Owner and provides copies for review.
5. The Owner reviews the modified documents and accepts.

DESIGN PHASE

Updated Owner's Project Requirements, updated Commissioning Plan, Basis of Design, and Contract Documents are formally accepted by the Owner during the Design Phase. The Owner's Project Requirements and the Commissioning Plan follow the same process as detailed in the Pre-Design Phase.

The general process for accepting the Basis of Design is:

1. The Commissioning Authority provides a list of information required and the format for the Basis of Design to the design professionals prior to the start of design.
2. The design professionals gather and organize the information during the creation of the design.
3. The design professionals submit the Basis of Design to the Owner and Commissioning Authority for review and comment with each design submittal.

4. Upon correction and resubmittal, the Owner accepts the Basis of Design based upon the recommendation of the Commissioning Authority.

The general process for accepting the Contract Documents is:

1. The design professionals submit the final package to the Owner and Commissioning Authority for review.
2. The Commissioning Authority evaluates the Contract Documents using random sampling to determine their ability to achieve the Owner's Project Requirements.
3. The Commissioning Authority meets with the design professionals to discuss and resolve comments.
4. Upon resolution of comments, the Commissioning Authority recommends to the Owner acceptance of the documents.
5. Owner reviews the comments, their resolution, and accepts the Contract Documents.

CONSTRUCTION PHASE

Updated Owner's Project Requirements, updated Commissioning Plan, updated Basis of Design, Systems Manual, training program, and a preliminary and a final Construction Phase Commissioning Process Report are formally accepted by the Owner during the Construction Phase. The Owner's Project Requirements, Commissioning Plan, and Basis of Design follow the same process as previously detailed.

The general process for accepting the Systems Manual is:

1. The Commissioning Authority tracks the Contractor submittals for the required documentation.
2. Within XX days of submittal acceptance for a system or assembly, the Contractor submits a draft Systems Manual to the Owner, Commissioning Authority, and design professionals.
3. The Commissioning Authority consolidates the reviews and meets with the design professionals to discuss and resolve.
4. The Contractor submits to the Commissioning Authority changes to the accepted submittals throughout construction.
5. XX days prior to the first training session, the Contractor submits the final Systems Manual to the Owner, Commissioning Authority, and design professionals.
6. The Owner accepts the final Systems Manual based upon the recommendation of the Commissioning Authority.

The general process for accepting the training program is:

1. The Commissioning Authority provides the training agenda to the Contractor.
2. The Contractor develops the training program, including identifying the trainer, the schedule of sessions, and the material to be developed. This information is submitted to the Owner, Commissioning Authority, and design professionals for review and comment.
3. Based upon the recommendation of the Commissioning Authority, the Owner accepts the training program.

4. The Contractor then develops the training material and submits it to the Owner, Commissioning Authority, and design professionals for review and comment XX days prior to the first training session.
5. Based upon the recommendation of the Commissioning Authority, the Owner accepts the training materials.
6. The Contractor implements the training program.
7. The Commissioning Authority randomly quizzes the trainees two weeks after the completion of a session.
8. The Contractor submits copies of all training materials and edited videotapes of the sessions.
9. The Commissioning Authority recommends acceptance of the completed training program to the Owner.

The general process for accepting the facility is:

1. Throughout construction the Commissioning Authority randomly samples the completion of the Construction Checklists for achieving the Owner's Project Requirements.
2. The Commissioning Authority directs the completion of system and assembly testing by the Contractor and documents the results.
3. The Commissioning Authority works with the Contractor in resolving any issues identified during testing.
4. The Commissioning Authority verifies that all system documentation is received from the Contractor.
5. The Commissioning Authority presents a preliminary Construction Phase Commissioning Process Report prior to occupancy that provides an evaluation of achieving each element of the Owner's Project Requirements, including recommendations to the Owner for acceptance/rejection of the facility.
6. The Commissioning Authority provides a final Construction Phase Commissioning Process Report with details on the Commissioning Process Activities completed during the Construction Phase.

OCCUPANCY AND OPERATIONS PHASE

Updated Owner's Project Requirements, updated Basis of Design, updated Systems Manual, seasonal test results, and Commissioning Process Report are formally accepted by the Owner during the Occupancy and Operations Phase. The Owner's Project Requirements, Basis of Design, and Systems Manual follow the same process as previously detailed.

The general process for accepting the seasonal test results is:

1. The Commissioning Authority directs the completion of seasonal system and assembly testing by the Contractor and documents the results.
2. The Commissioning Authority works with the Contractor in resolving any issues identified during testing.
3. The Commissioning Authority verifies that all updated system documentation is received from the Contractor.
4. The Commissioning Authority recommends to the Owner acceptance of the seasonal testing results.

The general process for accepting the Commissioning Process Report is:

1. The Commissioning Authority provides the Commissioning Process Report to the Owner, design professionals, and Contractor for review and comment.
2. The Commissioning Authority incorporates comments and provides a final copy to the Commissioning Team members.
3. The Owner accepts the Commissioning Process Report, ending the Commissioning Authority's responsibilities.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX I OWNER'S PROJECT REQUIREMENTS WORKSHOP GUIDANCE

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

The Owner's Project Requirements are considered the heart and soul of the Commissioning Process. When the Owner's Project Requirements are not developed, the owner, designer, contractors, and operation and maintenance (O&M) personnel each interpret the building requirements, including their individual responsibilities, from the standpoint of their own specific needs. This often creates a range of diverse views of the constructed project's needs. Unfortunately, while critical for a successful project, the Owner's Project Requirements are rarely developed. Developing Owner's Project Requirements that reflect the actual needs of the owner, the users or occupants, service and operating units, and sometimes the community is one of the, if not the, most important aspects for successful implementation of the Commissioning Process.

The following sections detail an example format to follow in developing the Owner's Project Requirements and a discussion of how to obtain the required information. Note that historically the Owner's Project Requirements have often been referred to as "design intent" or "project intent."

FORMAT

While there have been many formats used for presenting criteria for the Owner's Project Requirements, the Owner's Project Requirements workshop is one that has been well received by owners, designers, contractors, and O&M personnel. The workshop initially addresses general needs/requirements and progresses to specific requirements (i.e., moves from project needs to system/equipment/control needs). It is organized around and focuses upon assemblies and systems that have been identified as targets of the Commissioning Process. The workshop needs to be well organized, and it is very desirable to have the results formatted for immediate input into a computer analysis program for rapid feedback on consensus of the group.

Information from the workshop is only one of various resources from which the Owner's Project Requirements document is developed. Following is a description of some of the information that can be included in an Owner's Project Requirements document.

Key sections of the Owner's Project Requirements document are:

- **Background** – A narrative description to provide context about the project.
- **Objectives** – For any project there are goals that must be achieved for the project to be successful. Goals can range from first cost, to time schedule, to number of change orders, or to life-cycle cost. Regardless of which goals are identified, they must be summarized up front to ensure everyone is on the same page.
- **Green building concepts** – This is an optional section for owners who wish to focus upon the sustainability aspects of their building.
- **Functional uses and requirements** – In addition to general documentation produced by the architect on functional uses of the building (office, storage, kitchen, etc.), the specific requirements for each functional area must be documented. This can include such items as security, safety, comfort, energy, maintainability, and indoor air quality.
- **Lifespan, cost, and quality** – It is important to clearly document the owner's expectations for lifespan of materials, cost of construction, and the level of quality desired. By providing this information, unrealistic expectations are identified and eliminated.
- **Performance criteria** – Often the most difficult to define, performance criteria detail minimum acceptable performance benchmarks for various aspects of the facility.
- **Maintenance requirements** – The maintenance requirements are a mixture of the level of knowledge of the current O&M staff (what can they maintain) and the expected complexity of the proposed systems (what they can learn). If there is a significant gap between the two, no matter how well the building is constructed, it will not be maintained or operated properly.

The following are examples of Owner's Project Requirements elements that are common to most of the Technical Commissioning Process Guideline topics;

- **Benchmarks for performance** – Specific criteria for the functional use of each space, assembly, and system must be defined. These include temperature, humidity, air-flow, light, noise, durability, aesthetics (materials and colors), service life, reliability, redundancy, and the like. Typically, upper and lower limits are provided for general spaces, with exceptions noted as required.
- **Problems to avoid** – Since occupant/user/operator complaints are common, it is important to identify and document those problems that have caused complaints in the past. If these problems are not documented and the situation recurs, the occupants often consider the entire project as a failure.

- Specific occupant requirements – Specific items that are deemed important to the various occupants in a building must be identified and documented. In speculatively built buildings, this section would detail the limits to which occupants can make use of their spaces. For example, a chemical laboratory cannot be put in a space designed and constructed for general office use without significant changes to the systems and possibly to the building as a whole.

OBTAINING THE INFORMATION

While it may be easy to obtain the information related to development of the Owner's Project Requirements, it is difficult to obtain quality information that the owner, O&M staff, service contractors, customers (i.e., students, patients, retail customers, renters), visitors, subtenants, occupants, and the community all agree upon. In quality-based processes, it is critical that input be obtained from all the users (the various user groups) and that the consensus of and differences between the groups be documented. There usually are requirements for which users do not all agree. These must be documented as unresolved items. Normally, the owner will make final decisions on what the priority order of Owner's Project Requirements will be. However, the owner and the rest of the Commissioning Team must be aware of all requirements so that the final product will include as many individual group requirements as are deemed appropriate and within the budget.

A simple three-step process is recommended for developing the Owner's Project Requirements:

1. Owner's Project Requirements workshop.
2. Owner's Project Requirements documentation (report).
3. Project team approval of the Owner's Project Requirements.

Owner's Project Requirements Workshop

The Owner's Project Requirements workshop is typically facilitated by the Commissioning Authority (CxA), who elicits the primary concerns of the project team. The workshop is organized to encourage identification of all requirements, to encourage interaction and discussion among all team members, and to arrive at group consensus of priorities for the Owner's Project Requirements. This is accomplished through the presentation of multiple questions in an ordered structure. A typical process uses a modified Nominal Group Technique workshop format. This is a formal means of gathering the highest level of consensus that approaches the real needs of the group. The procedure consists of the following steps:

- Provide each question or open concept to each individual participating in the workshop.
- Allow three to five minutes of quiet writing time for each individual to respond with as many answers and ideas as he/she can.
- Record individual responses in a round-robin fashion – no discussion at this point, just record the responses on a visual flipchart, overhead, chalkboard, or multi-computer link to all participants.

- Review all responses, consolidate similar ones, and clarify so all in the group have the same understanding of all responses.
- Have individuals rank the responses for importance (1 through 5).
- Determine a group ranking from individual rankings.
- A re-discussion of the top 10 items—and any responses ranked most important—is desired, followed by a second round of individual and group combined rating/ranking.

The questions asked during this workshop must be broad in nature, elicit discussion, result in a variety of viewpoints, and must not leave the workshop. The questions should not focus on such items as “at what temperature are you comfortable?” but should be broader, such as “how do you define comfort?” or “how will you measure the cost success of this project?” (versus a broader question, such as “how will you determine if this was a successful project?”).

Owner's Project Requirements Documentation

The Owner's Project Requirements workshop will identify key items and priorities important to the project team, the owner, users, and the Commissioning Team. However, it does not provide specific values. For example, the number one Owner's Project Requirement may be good air circulation in the rooms. It is the responsibility of the Commissioning Authority to take the individual requirements developed by the project team and translate them into physical properties that can be measured, designed, and documented.

This transformation of the Owner's Project Requirements often requires input from a variety of sources, including the design team, contractors, specialists, standards, and guidelines. Typically, the Commissioning Authority has sufficient experience in the planning, design, construction, and operation of facilities to provide the oversight of such a task. If not, then experts should be retained to aid in the development of the Owner's Project Requirements.

Project Team Approval of the Owner's Project Requirements

After several iterations and reviews of the Owner's Project Requirements by the project and design teams, the requirements must be approved to provide the design team adequate direction for their design. It is important to distinguish development of the Owner's Project Requirements from the traditional role of the architect in the planning or programming process. The Owner's Project Requirements define the criteria required for success, whereas the architect's document may only address specific space size and occupant flow requirements. Where the Owner's Project Requirements may state that the functional use of the facility is X, Y, and Z, the architect's document may specify the locations of, the size of, and the flow of people through X, Y, and Z.

SUMMARY

The Owner's Project Requirements workshop is one means to provide consistency in the implementation of the Commissioning Process from project to project. It should be a topic addressed in the lessons-learned workshop during the

Occupancy and Operations Phase of the Commissioning Process. Other techniques for developing the Owner's Project Requirements, such as interviews and surveys, do not allow interaction between the user groups. Further, it has been shown that the results or answers are biased by the beliefs of the expert who develops the questions for the interviews or surveys. Frequently, using such techniques the questions can be analyzed and the conclusions pre-determined whether the interviews or surveys are completed or not.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX J OWNER'S PROJECT REQUIREMENTS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

A general format for an Owner's Project Requirements document is presented in this annex. The structure provided is intended to encompass the facility requirements and enable the addition of sections depending upon the systems and assemblies to be constructed.

Introduction – Includes an overview of the project and the general reasons why the project is being undertaken. A description of the owner's processes (Commissioning Process) is typically contained in this section.

Key Owner's Project Requirements – Includes a listing of the key Owner's Project Requirements that the Commissioning Process will focus upon and that the owner (Commissioning Team) has determined are critical to the success of the project.

General Project Description - The size and scope of the project are included in this section.

Objectives – The objectives for accomplishing this project are detailed in this section.

Functional Uses – The expected functional uses (spaces) for the facility are detailed in this section. A short description of each functional use is included to provide the context in which it was detailed.

Occupancy Requirements – Includes the number of occupants (users and visitors) and the schedule of occupancy, including all special conditions.

Budget Considerations and Limitations – The expected budgetary restrictions and considerations are contained in this section.

Performance Criteria – The performance criteria upon which the project will be evaluated by the Commissioning Team are included in this section. Each performance criterion should be measurable and verifiable. Include subsections as appropriate to organize and explain the criteria:

- General
- Economic
- User Requirements
- Construction Process
- Operations
- Systems
- Assemblies

Owner's Project Requirements Version History – Includes a summary of the changes made throughout the Pre-Design, Design, Construction, and Occupancy and Operations Phases. This information is critical to understand and document the trade-offs made over time and the resulting impact on the project.

The following table will assist in the development of the Owner's Project Requirements document in accordance with Section 5.2.2.4 using the format presented in this annex. The table is also applicable for those developing Technical Supporting Guidelines as described in Annex A. Inclusion of specific criteria (such as the entries in this example matrix) will depend upon the project and the owner's needs. The Key Owner's Project Requirements Section should emphasize those OPR that are essential to the success of the project.

TABLE J-1 Example Matrix for Developing Owner's Project Requirements

| | Guideline 0-2005 Subclause 5.2.2.4 Criteria | OPR Document Section | | | | | | | |
|------|---|----------------------|----------------------------------|-----------------------------|------------|-----------------|------------------------|---------------------------------------|--|
| | | Introduction | Key Owner's Project Requirements | General Project Description | Objectives | Functional Uses | Occupancy Requirements | Budget Considerations and Limitations | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| (a) | Project schedule and budget | | | Schedule | | | | Budget | |
| (b) | Commissioning Process scope and budget | Scope | | | | | | Budget | |
| (c) | Project documentation requirements, including format for submittals, training materials, reports, and the Systems Manual. Consideration should be given to use of electronic format documents and records where appropriate | | X | | | | | | |
| (d) | Owner directives | | X | | | | | | |
| (e) | Restrictions and limitations | | | X | | | | | |
| (f) | User requirements | | X | | | | | | |
| (g) | Occupancy requirements and schedules | | | | | X | X | | |
| (h) | Training requirements for Owner's personnel | | X | | | | | | |
| (i) | Warranty requirements | | X | | | | | | |
| (j) | Benchmarking requirements | | X | | | | | | |
| (k) | Operation and maintenance criteria for the facility that reflect the Owner's expectations and capabilities and the realities of the facility type | | X | | | | | | |
| (l) | Equipment and system maintainability expectations, including limitations of operating and maintenance personnel | | X | | X | | | | |
| (m) | Quality requirements for materials and construction | | X | | | | | | |
| (n) | Allowable tolerance in facility system operations | | | | X | | | | |
| (o) | Energy efficiency goals | | X | | X | | | | |
| (p) | Environmental and sustainability goals | | X | | X | | | | |
| (q) | Community requirements | | X | | | | | | |
| (r) | Adaptability for future facility changes and expansion | | X | | X | X | | | |
| (s) | Systems integration requirements, especially across disciplines | | | | | X | | | |
| (t) | Health, hygiene, and indoor environment requirements | | X | | | | X | | |
| (u) | Acoustical requirements | | X | | | | | | |
| (v) | Vibration requirements | | X | | | | | | |
| (w) | Seismic requirements | | X | | | | | | |
| (x) | Accessibility requirements | | X | | | | | | |
| (y) | Security requirements | | X | | | | | | |
| (z) | Aesthetics requirements | | X | | | | | | |
| (aa) | Constructability requirements | | X | | | | | | |
| (bb) | Communication requirements | | X | | | | | | |
| (cc) | Applicable codes and standards | | | X | | | | | |

TABLE J-1 (Continued) Example Matrix for Developing Owner's Project Requirements

| | Guideline 0 Body | OPR Document Section | | | | | | | |
|------|---|----------------------|----------|-------------------|----------------------|------------|---------|------------|---------------------|
| | | Performance Criteria | | | | | | | OPR Version History |
| | | General | Economic | User Requirements | Construction Process | Operations | Systems | Assemblies | |
| | | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| (a) | Project schedule and budget | | | | | | | | |
| (b) | Commissioning Process scope and budget | | | | | | | | |
| (c) | Project documentation requirements, including format for submittals, training materials, reports, and the Systems Manual. Consideration should be given to use of electronic format documents and records where appropriate | | | | | | | | |
| (d) | Owner directives | | | | | | | | |
| (e) | Restrictions and limitations | | | | | | | | |
| (f) | User requirements | | | X | | | | | |
| (g) | Occupancy requirements and schedules | | | | | | | | |
| (h) | Training requirements for Owner's personnel | | | | X | X | | | |
| (i) | Warranty requirements | | | | | X | | | |
| (j) | Benchmarking requirements | | X | | X | X | X | | |
| (k) | Operation and maintenance criteria for the facility that reflect the Owner's expectations and capabilities and the realities of the facility type | | | | | X | X | X | |
| (l) | Equipment and system maintainability expectations, including limitations of operating and maintenance personnel | | | | X | X | X | | |
| (m) | Quality requirements for materials and construction | X | | | X | | X | X | |
| (n) | Allowable tolerance in facility system operations | | | | | X | X | | |
| (o) | Energy efficiency goals | | X | | | X | X | X | |
| (p) | Environmental and sustainability goals | X | | | | | | | |
| (q) | Community requirements | X | | | | | | | |
| (r) | Adaptability for future facility changes and expansion | | | | X | X | X | X | |
| (s) | Systems integration requirements, especially across disciplines | X | | | X | | | | |
| (t) | Health, hygiene, and indoor environment requirements | | | X | | | | | |
| (u) | Acoustical requirements | X | | X | X | | | | |
| (v) | Vibration requirements | X | | | X | | | | |
| (w) | Seismic requirements | X | | | X | | | | |
| (x) | Accessibility requirements | X | | X | X | X | | | |
| (y) | Security requirements | X | | X | X | | | | |
| (z) | Aesthetics requirements | X | | X | X | | | | |
| (aa) | Constructability requirements | X | | | X | | | | |
| (bb) | Communication requirements | X | | X | X | | | | |
| (cc) | Applicable codes and standards | | | | | | | | |

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX K BASIS OF DESIGN

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

The Basis of Design document records the major thought processes and assumptions behind design decisions made to meet the Owner's Project Requirements. The Owner's Project Requirements are intended to capture "what" the owner needs and expects from a project. The Construction Documents detail "how" the Owner's Project Requirements will be physically achieved. The Basis of Design captures important information linking the "what" and "how."

Basis of Design documentation is distinct from the Construction Documents, is seldom included in drawings and specifications, and is generally not needed by the Contractor to meet his/her obligations. It is exceptionally valuable to the Commissioning Team, however, when evaluating the ability of a design and its components to meet the Owner's Project Requirements.

The objective of specifically documenting Basis of Design information is to provide the parties involved with a project, at each phase in the process, an understanding of the underlying thinking that led to the selection of specific components, assemblies, systems, and system integrations. A design narrative that provides an overview of assemblies and systems in verbal format is usually an integral element of the Basis of Design.

The Basis of Design document will typically be developed incrementally as work on a project moves from Pre-Design, to Design, and into the Construction Phase. Changes to the Basis of Design that often occur as a design evolves must be documented.

Content of the Basis of Design document will vary from project to project and system to system, but in general it should address the following:

- Specific codes, standards, and guidelines considered during design of the facility and designer interpretations of such requirements.
- Information regarding ambient conditions (climatic, geologic, structural, existing construction) used during design.
- Assumptions regarding usage of the facility.
- Expectations regarding system operation and maintenance.
- Performance criteria that the system was designed to meet – linked to the Owner's Project Requirements.
- Specific design methods, techniques, software used in design.
- A narrative statement of design – that verbally describes how the designer intends to meet the Owner's Project Requirements.

- A narrative statement of operation – that verbally details how the facility is expected to operate under various situations (such as normal operation, extreme event, emergency).
- A listing of specific manufacturer makes and models used as the basis for drawings and specifications.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX L SPECIFICATIONS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

1. SPECIFICATIONS FOR THE COMMISSIONING PROCESS

1.1 This annex provides guidance on writing specifications for Commissioning Process activities to be performed by construction contractors. A guide specification is included with the assumption that the construction contractor is involved only during the construction phase and for the correction and warranty period.

1.2 Commissioning is a quality-oriented process for achieving, verifying, and documenting that the performance of facility systems and assemblies meets defined objectives and criteria. The Commissioning Process begins at project inception during the Pre-Design Phase and continues for the life of the facility through the Occupancy and Operations Phase. During the Pre-Design Phase, the Owner's Project Requirements (OPR) are determined and documented by the Commissioning Team, which includes the Owner, Commissioning Authority (CxA), design professionals, operation and maintenance personnel, occupants, and users. Throughout each phase of the project, deliverables (drawings, specifications, submittals, construction, training, documentation, etc.) are verified against the OPR.

1.3 An important document created during the Commissioning Process is the Basis of Design document or report (BoD). The design professionals create this document or report during the design phase. The BoD records the concepts, calculations, decisions, and product selections to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. It can include energy, environmental, sustainability, and other certification criteria, both formal and informal. The BoD includes both narrative descriptions and lists of individual items that support the design process.

1.4 ASHRAE or NIBS Guideline 0 provides guidance on content and basic format. While the OPR are Owner-developed criteria, few Owners have the resources to develop the

OPR. Owners without these resources depend on the Commissioning Team (see a definition and discussion of the term *Commissioning Team* in this guideline) to assist them in developing the OPR.

1.5 The OPR and BoD must be included or referenced in the construction Contract Documents for informational purposes only.

1.6 The construction contractor's obligation is to construct the building and its systems and assemblies according to the requirements prescribed in the Contract Documents. There normally are no performance requirements relating to the OPR stated in the Contract Documents. The exceptions to this include situations where contractors are required to provide designs for systems or assemblies to be signed and sealed by licensed professionals.

2. THE COMMISSIONING AUTHORITY (CxA)

2.1 The primary role of the CxA is to verify achievement of the OPR throughout the project, from Pre-Design Phase through Occupancy and Operations Phase. The Owner should perform this role.

2.2 When the Owner cannot perform the CxA duties with qualified personnel, then the CxA should have a separate professional services agreement with the Owner, as this avoids conflicts of interest and provides independence from the other parties (the Owner's project manager, designers of record, construction managers, suppliers, and construction contractors). This professional services agreement defines the duties, rights, and responsibilities of the CxA for each phase of the project. This separate relationship allows the CxA to act independently as director of Commissioning Process activities, to focus on achieving the OPR, and to communicate directly with the Owner.

2.3 The CxA is a group of personnel with expertise and experience in the design, construction, and operations of the various systems and assemblies included in the project. These personnel are led by an individual who has expertise and experience in successfully implementing the Commissioning Process.

2.4 If the CxA is an employee, associate, or partner of the same organization as the designer of record or construction management firm, there is a conflict of interest. While not a recommended approach, in these instances the CxA must have a separate professional services agreement, be organizationally separate from the design team or construction management team, and define and manage the conflicts of interest

to provide the Owner with the independence required for the Commissioning Process to be successful.

2.5 The CxA does not perform testing; it directs the process and directs the recording of the results. The CxA plans, schedules, and supervises Commissioning Process activities to verify achievement of the OPR. The Contractor completes construction checklists, performs tests, and accomplishes other Commissioning Process activities.

3. ORGANIZATIONAL STRATEGY FOR INCLUSION OF COMMISSIONING ACTIVITIES IN THE SPECIFICATIONS

3.1 Specifications (as a part of the construction Contract Documents) should include only the Commissioning Process activities the contractors perform during the life of the construction contract, including the work required during the correction period and for warranties.

3.2 *Supplementary Conditions*: Modify the General Conditions of the Contract for Construction in a document titled "Supplementary Conditions." Among other provisions, define the CxA and include the CxA's duties, rights, responsibilities, and limits of authority and additional requirements for substantial completion. AIA Document A511, "Guide for Supplementary Conditions," provides guidance about how to write Supplementary Conditions.

3.3 *General Requirements for the Commissioning Process*: Specifications in Division 1 include the general requirements for contractors relating to Commissioning Process activities. The "Summary" Section describes, in general, how the Contractors, separate Contractors (if there is more than one Prime Contractor), or the Construction Manager must interact with the CxA. Administrative procedures for the Commissioning Process are specified in the Division 1 Section "Commissioning."

3.3.1 The remainder of the specification language, with the exception of Division 1 sections for temporary facilities and controls, should be mute on the subject of who must perform the work.

3.3.2 Other Division 1 Commissioning Sections should describe the testing requirements for systems and assemblies.

3.3.2.1 References in Table L-1 are to MASTER-SPEC® section numbers and titles existing at the time this annex was written. Refer to the current MASTERSPEC consolidated table of contents because section numbers and titles may have changed.

TABLE L-1 Description of Specification Sections

| SEC NO. | DOCUMENT/SECTION | LIST OF CONTENTS | SCOPE OF CONTENTS |
|---------|--|---|--|
| 01100 | SUMMARY | <p>Work covered by Contract Documents</p> <p>Identification of separate prime contractors</p> | <p>Describe Commissioning Process activities as a part of the project.</p> <p>Alert the Contractor that the Owner has contracted for commissioning with a separate Commissioning Authority.</p> <p>Delineate scope of Commissioning Process.</p> |
| 01290 | PAYMENT PROCEDURES | | No special Commissioning Process requirements. |
| 01310 | PROJECT MANAGEMENT AND COORDINATION | Provisions about coordination of Commissioning Process activities among contractors and sub-contractors; project meetings. | Add requirements to include CxA in coordination meetings (particularly “Pre-Construction Meeting”). Coordination of meetings and conferences. |
| 01330 | SUBMITTAL PROCEDURES | Procedures for submittals | <p>Submittal requirements for Commissioning Process activity reports and schedules should be specified in Sections 01811 to 01819.</p> <p>Add requirements here for additional copies from Contractor to CxA and for approved submittals to be distributed to CxA.</p> |
| 01400 | QUALITY REQUIREMENTS | | Coordinate with Commissioning Process activities, witnessing of tests, and test reports. |
| 01500 | TEMPORARY FACILITIES AND CONTROLS | | Include office space for CxA and utility services for Commissioning Process activities. |
| 01600 | PRODUCT REQUIREMENTS | | No special Commissioning Process requirements. |
| 01731 | CUTTING AND PATCHING | | No special Commissioning Process requirements. |
| 01770 | CLOSEOUT PROCEDURES | | Include key Commissioning Process milestones to achieve substantial completion and closeout. |
| 01782 | OPERATION AND MAINTENANCE DATA | | <p>Include requirements for CxA to review and recommend approval of Systems Manual.</p> <p>Same procedures as described for Section 01330—Submittals.</p> |
| 01810 | GENERAL COMMISSIONING REQUIREMENTS | | General administrative and procedural requirements without regard to specific systems and assemblies. |
| 01811 | BUILDING ASSEMBLY COMMISSIONING REQUIREMENTS | <p>Substructure</p> <p>Superstructure</p> <p>Building Shell</p> <p>Exterior Wall Assemblies</p> <p>Roof Assemblies</p> <p>Building Interior</p> <p>Separations</p> <p>Paths of Egress</p> | <p>Lists of Construction Checklists</p> <p>Prerequisites to Testing</p> <p>System or Assembly Test Requirements</p> <p>Test Reports</p> |
| 01812 | CONVEYING SYSTEM COMMISSIONING REQUIREMENTS | <p>Elevators and Lifts</p> <p>Escalators and Moving Walks</p> | <p>Lists of Construction Checklists</p> <p>Prerequisites To Testing</p> <p>System or Assembly Test Requirements</p> <p>Test Reports</p> |
| 01813 | PROTECTIVE SYSTEM COMMISSIONING REQUIREMENTS | <p>Fire Suppression (including pumps, sprinkler and standpipe piping, and terminal devices)</p> <p>Detection and Alarms (including fire, smoke, gas, and leak)</p> <p>Lightning Protection (this is not part of electrical distribution)</p> <p>Cathodic Protection (this is not part of electrical distribution)</p> | <p>Lists of Construction Checklists</p> <p>Prerequisites to Testing</p> <p>System or Assembly Test Requirements</p> <p>Test Reports</p> |

TABLE L-1 (Continued) Description of Specification Sections

| SEC NO. | DOCUMENT/SECTION | LIST OF CONTENTS | SCOPE OF CONTENTS |
|---------|---|---|---|
| 01814 | PLUMBING SYSTEM COMMISSIONING REQUIREMENTS | Water Distribution Sanitary Waste Storm Drainage Other Plumbing Systems | Lists of Construction Checklists Prerequisites to Testing System or Assembly Test Requirements Test Reports |
| 01815 | HVAC&R SYSTEM COMMISSIONING REQUIREMENTS | Heat Generation (including central equipment, distribution systems, and terminal devices) Refrigeration (including central equipment, distribution systems, and terminal devices) Ventilation (including central equipment, distribution systems, and terminal devices) HVAC Control Systems (including central equipment, distribution systems, and terminal devices) | Lists of Construction Checklists Prerequisites to Testing System or Assembly Test Requirements Test Reports |
| 01816 | ELECTRICAL SYSTEM COMMISSIONING REQUIREMENTS | Power Distribution (including central equipment, distribution circuits, and terminal devices) Lighting (includes fixtures and controls) | Lists of Construction Checklists Prerequisites to Testing System or Assembly Test Requirements Test Reports |
| 01817 | COMMUNICATIONS SYSTEMS COMMISSIONING REQUIREMENTS | Voice and Data Sound and Video | Lists of Construction Checklists Prerequisites to Testing System or Assembly Test Requirements Test Reports |
| 01818 | ELECTRONIC SAFETY AND SECURITY SYSTEMS COMMISSIONING REQUIREMENTS | Security Access, Perimeter Security, Intrusion Detection, Alarm and Detection Systems (including fire and smoke and leak detection) | Lists of Construction Checklists Prerequisites to Testing System or Assembly Test Requirements Test Reports |
| 01820 | DEMONSTRATION | | Coordination requirements with the CxA |
| | INDIVIDUAL SECTIONS IN DIVISIONS 2 THROUGH 16 | Field Quality Control Tests Adjusting and Balancing Cleaning Demonstration | A statement requiring system, subsystem, or equipment to be commissioned as a part of its parent system. A statement requiring Contractor to complete construction checklists and perform tests. |

3.3.3 Extent of Testing: The contractor's involvement in Commissioning Process tests must be clearly defined. The extent of this testing is determined by the Commissioning Team during the Design Phase based upon the OPR.

3.4 Component Commissioning Process Specifications: Sections in Divisions 2 through 16 should specify testing and reporting requirements for products and equipment that are part of a system or assembly and then be referenced to the appropriate Commissioning Process sections in Division 1 for the overall system or assembly requirements.

3.4.1 During construction the CxA verifies that contractor activities, such as installation and start-up; testing; demonstration and training of the Owner's operator and maintenance personnel; and Systems Manual, achieve the OPR. Coordinating activities by the contractor in support of the CxA should be specified within the section where the component is specified (i.e., in individual sections in Divisions 2 through 16) if special requirements are necessary. The following are examples of requirements to include in individual sections in Divisions 2 through 16:

3.4.1.1 Installation and Start-up: Include requirements for involvement of factory-authorized service representative in individual sections and for the completion of construction checklists.

3.4.1.2 Testing: Include requirements to support the CxA in verifying test results, ranging from coordinating testing, to witnessing the test, to utilizing contractor personnel and test equipment to verify the test report.

3.4.1.3 Demonstration and Training: Include special requirements unique to the component within its own section.

3.4.1.4 Operation and Maintenance Data: Include unique requirements for the type of information required (e.g., particular requirements about parts lists, service schedules, preventive maintenance lists, and emergency operations) for long-term maintenance of the OPR.

3.4.2 In each section include an article under "General" that refers to Division 1 for Commissioning Process activities for system or assembly requirements. An example is as follows:

1.XX Commissioning Process Activities

- A. The roofing materials specified in this Section are included in the Commissioning Process as a part of the building envelope system and roofing subsystem and integrated with flashing, coping, and insulation.
- B. Complete the construction checklists and perform tests specified in the Division 1 Section “Building Assemblies Commissioning Requirements.”

4. INTRODUCTION TO GUIDE SPECIFICATIONS

This Specification Section was written in cooperation with Architectural Computer Services, Inc. (ARCOM), who are the exclusive publishers and distributors of MASTERSPEC, a product of the American Institute of Architects. MASTERSPEC Section 01 9113—General Commissioning Requirements—is included in Guideline 0 by special agreement between ASHRAE and ARCOM.

4.1 The section includes boxed notes that are instructions to guide specifiers during editing of the specifications for a project.

4.2 The section includes optional text in boldface font and square brackets (e.g., [**optional text**]). These optional text items include text that often occurs and provides an easy way to include these requirements in the master for consideration for each project.

4.3 The section includes insert instructions in boldface font and angle brackets (e.g., <**Insert instructions**>). These instructions are placed where text must be inserted and provide some guidance about the nature of the text that must be inserted. Insert instructions are used when there are an infinite number of options that could occur making the use of [**Optional text**] impractical.

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SECTION 01 9113 - GENERAL COMMISSIONING REQUIREMENTS

This Section uses the term “Architect.” Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Throughout the Section, the optional text “[**each**]” is included with the term “Contractor.” Retain “each” for projects that include multiple prime contractors; delete for projects that have a single prime contractor.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

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.

Documents referenced in paragraph below should be prepared during schematic design phase or earlier and updated as design progresses. They should be provided to Contractor when the commissioning process is implemented on Project.

- B. OPR and BoD documentation are included by reference for information only.

1.2 SUMMARY

- A. This Section includes general requirements that apply to implementation of the commissioning process without regard to specific systems, assemblies, and components.
- B. Related Sections include the following:

List below only requirements that the reader might expect to find in this Section but are specified elsewhere. The first four and the last three subparagraphs are not yet available in MASTERSPEC but should be written and included if total building commissioning is implemented.

1. Division 01 Section "Facility Substructure Commissioning" for commissioning process activities for foundations and basement systems and assemblies.
2. Division 01 Section "Facility Shell Commissioning" for commissioning process activities for superstructure, exterior enclosure, and roofing systems and assemblies.
3. Division 01 Section "Interiors Commissioning" for commissioning process activities for interior construction, stairways, and interior finishes systems and assemblies.
4. Division 14 Section "Commissioning of Conveying Equipment" for commissioning process activities for dumbwaiters, elevators, escalators and moving walks, lifts, turntables, and scaffolding systems, assemblies, equipment, and components.
5. Division 21 Section "Commissioning of Fire Suppression" for commissioning process activities for fire suppression systems, assemblies, equipment, and components.
6. Division 22 Section "Commissioning of Plumbing" for commissioning process activities for plumbing systems, assemblies, equipment, and components.
7. Division 23 Section "Commissioning of HVAC&R" for commissioning process activities for commissioning heating, ventilating, air-conditioning, and refrigeration systems, assemblies, equipment and components.
8. Division 25 Section "Commissioning of Integrated Automation" for commissioning process activities for commissioning integrated automation systems, assemblies, equipment and components.
9. Division 26 Section "Commissioning of Electrical" for commissioning process activities for electrical systems, assemblies, equipment, and components.
10. Division 27 Section "Commissioning of Communications" for commissioning process activities for communication systems, assemblies, equipment, and components.
11. Division 28 Section "Commissioning of Electronic Safety and Security" for commissioning process activities for electronic safety and security systems, assemblies, equipment, and components.
12. Division 33 Section "Commissioning of Utilities" for commissioning process activities for water, wells, sanitary sewerage, storm drainage, fuel distribution, hydronic and steam energy, electrical, and communications utilities systems, assemblies, equipment, and components.

1.3 DEFINITIONS

Retain acronyms, abbreviations, and terms below that remain after this Section has been edited.

- A. BoD: Basis of Design. A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions

and lists of individual items that support the design process.

- B. Commissioning Plan: A document, prepared by CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Assemblies, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of [each] Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
 1. CxA: An entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
 2. Representatives of the facility user and operation and maintenance personnel.
 3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and [each] Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

Coordinate activities specified in paragraph below with Owner-Architect and Architect-Consultant agreements.

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

1.6 [EACH]CONTRACTOR'S RESPONSIBILITIES

Coordinate this Article with requirements specified in Division 01 Section "Summary of Multiple Contracts" for Project Coordinator's responsibilities.

- A. **[Each]** Contractor and their subcontractors shall assign representatives with expertise and authority to act on their behalf and schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the CxA for resolution of issues recorded in “Issues Log.”
 3. Attend and participate in commissioning team meetings held **[weekly]** **[biweekly]** **[monthly]** **[variable]** **<Insert frequency>**.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and accept construction checklists provided by the commissioning authority.
 6. Complete **[paper]** **[electronic]** construction checklists as Work is completed and provide to the commissioning authority on a **[daily]** **[weekly]**, **<Insert frequency>**, basis.
 7. Review and accept commissioning process test procedures provided by the commissioning authority.
 8. Accomplish commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

Include CxA responsibilities in this Article that have impact on Contractor activities and responsibilities.

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, CxA will report the failure in the “Issues Log.”

- F. Prepare and maintain issues log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning process report.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 9113

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX M CONSTRUCTION CHECKLISTS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

OVERVIEW

Construction Checklists consist of two types:

Component/Equipment Based: These Construction Checklists are utilized for components and pieces of equipment that are delivered, installed, and started up during construction. There is an individual checklist for each individual component or piece of equipment.

System/Assembly Based: These Construction Checklists are utilized for systems and assemblies where separate checklists cannot be applied to subcomponents of the system or assembly. There is a single checklist for the entire system.

The following provides a generic structure to follow for the development of Construction Checklists for any equipment, component, system, or assembly.

[INSERT EQUIPMENT/COMPONENT NAME] CHECKLIST

TAG ID: _____

GENERAL INSTRUCTIONS:

1. This form is to be completed as the work is completed on [insert equipment/component name].
2. Complete Section 1 – Model verification upon delivery of equipment/component to either the job site or storage location.
3. Complete Section 2 – Pre-installation checks just prior to initial installation.
4. Complete Section 3 – Installation as installation progresses.
5. Fill in data, circle item, and initial as indicated.

1. [INSERT EQUIPMENT/COMPONENT NAME] MODEL VERIFICATION

| | Specified | Submitted | Installed |
|--|------------------|------------------|------------------|
| [list items to check, such as make, model, and size] | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

2. PRE-INSTALLATION CHECKS

The following must be completed upon delivery of equipment/component to the work site.

| | | Contractor | Initial | CxA |
|-----------|---|-------------------|----------------|------------|
| 2A | Physical Checks | | | |
| | [insert physical checks to be verified prior to installation, such as “free of damage” and cleanliness] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| 2B | Component Verification | | | |
| | [insert component checks to be verified prior to installation, such as location and type of components] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |

3. INSTALLATION

The following items need to be verified during installation. Fill in blanks with check, specific information, or circle “yes” or “no.” For any negative responses, complete Section 4.

| | | Contractor | Initials | CxA |
|----|---|------------|----------|-----|
| 3A | [insert title of major installation step] | | | |
| | [insert items to verify as installation step is accomplished] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| 3B | [insert title of major installation step] | | | |
| | [insert items to verify as installation step is accomplished] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| 3C | [insert title of major installation step] | | | |
| | [insert items to verify as installation step is accomplished] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| 3D | [insert title of major installation step] | | | |
| | [insert items to verify as installation step is accomplished] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| 3E | [insert title of major installation step] | | | |
| | [insert items to verify as installation step is accomplished] | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |
| | | Yes / No | | |

4. NEGATIVE RESPONSES (ATTACH SHEETS AS NECESSARY)

| Item | Reason for negative response | Resolution |
|------|------------------------------|------------|
| | | |
| | | |
| | | |
| | | |

[INSERT SYSTEM/ASSEMBLY NAME] INSTALLATION CHECKLIST

GENERAL INSTRUCTIONS

1. This form is to be completed daily by each [insert system/assembly name] work crew at the end of its shift.
2. Date and describe work completed in the appropriate section (1 for pre-installation and 2 for installation).
3. Verify achievement of quality requirements by circling "Yes" or "No." For negative responses, complete Section 3.
4. Initial.

1. [INSERT SYSTEM/ASSEMBLY NAME] PRE-INSTALLATION CHECKS

| Date | Description of Work Performed | Items (see descriptions below) | | | | | Percent Complete | Initial |
|------|-------------------------------|--------------------------------|------------------|------------------|------------------|------------------|------------------|---------|
| | | [insert title A] | [insert title B] | [insert title C] | [insert title D] | [insert title E] | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |
| | | Yes / No | Yes / No | Yes / No | Yes / No | Yes / No | | |

[INSERT TITLE A]: [INSERT DESCRIPTION OF TITLE A]

[INSERT TITLE B]: [INSERT DESCRIPTION OF TITLE B]

[INSERT TITLE C]: [INSERT DESCRIPTION OF TITLE C]

[INSERT TITLE D]: [INSERT DESCRIPTION OF TITLE D]

[INSERT TITLE E]: [INSERT DESCRIPTION OF TITLE E]

2. [INSERT SYSTEM/ASSEMBLY NAME] INSTALLATION CHECKS

[illegible]

[INSERT TITLE F]: [INSERT DESCRIPTION OF TITLE F]

[INSERT TITLE G]: [INSERT DESCRIPTION OF TITLE G]

[INSERT TITLE H]: [INSERT DESCRIPTION OF TITLE H]

[INSERT TITLE I]: [INSERT DESCRIPTION OF TITLE I]

DRAWINGS UPDATED: THE INSTALLED SYSTEM IS SHOWN ON THE RECORD DRAWINGS.

3. CONFLICTS (ATTACH SHEETS AS NECESSARY)

| Date | Description of Conflict | Suggested Resolution | Resolved? |
|------|-------------------------|----------------------|-----------|
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |
| | | | Yes / No |

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX N QUALITY-BASED SAMPLING EXAMPLES

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

DESIGN PHASE SUBMISSIONS

A critical step in the Commissioning Process is the review of the design submissions from the design professionals. It is important to remember that the role of the Commissioning Authority is to verify that the Owner's Project Requirements are met and that the system is designed in a quality manner. There are three distinct reviews that are completed on a drawing set – general, coordination, and field specific. A review of the specifications is also required. The general steps of completing a drawing review are as follows:

GENERAL REVIEW

1. *Review the Owner's Project Requirements:* Since the drawing review is to verify that the Owner's Project Requirements were met, prior to the review, the Owner's Project Requirements should be reviewed to familiarize the reviewer with the key criteria of the facility.
2. *Document the General Review Criteria:* The criteria from which to accomplish the general review of the submission must be documented. The criteria should be based on general quality characteristics and specific Owner's Project Requirements criteria. The general quality characteristics should include items such as:
 - Continuation of items (ductwork, pipes, etc.) from page to page
 - Labeling, including correct room numbering
 - Details corresponding to actual components
 - Schedules including basis of design information
 - All information legible (not hidden by crossing lines or text)
 - Owner's Project Requirements information is included on drawings
3. *Accomplish Quick General Review:* The general review is intended to familiarize the reviewer with the submission. If during this review significant items are identified as of poor quality, then the review process should be stopped and the design professionals contacted to discuss the quality concerns. If the general quality is good, move on to the Coordination Review.

COORDINATION REVIEW

1. *Determine Sampling Areas:* For each floor plan area (i.e., if there are five sheets for each floor, then there are five floor plan areas for each floor) select a single 10" by 10" square

randomly. A simple way to do this is to divide the drawing sheet into 15 squares (5 by 3) and select square number 3 on the first sheet (area) and then 5, 7, etc., for each remaining area. This selection is accomplished typically using the architectural sheets.

2. *Select Review Samples on Drawings:* Using the sampling strategy chosen in Step 1, mark the sample areas to be reviewed in each area. This should be accomplished for each trade (landscaping, architectural, structural, plumbing, mechanical, electrical, etc.).
3. *Accomplish Coordination Review:* For each area, compare the squares between each discipline. The intent of this review is to identify coordination problems with the placement and installation of components. Items of specific interest include:
 - Placement of multiple pieces of equipment/components in the same location
 - Accessibility to equipment/components for maintenance/replacement
 - Use of consistent terminology (e.g., room numbers,)
 - Elevations provided where multiple systems are placed in the same area
 - Other trade duties clearly identified (e.g., electric wiring for HVAC equipment, holes for sinks)

If significant coordination problems are identified, stop the review and contact the design professionals to discuss. If the coordination is good, continue on with the Field Specific Review.

FIELD SPECIFIC REVIEW

1. *Determine the Review Sampling Procedure:* Use random sampling that selects every x^{th} square on the drawings to be verified. Squares that are completely blank (no walls, equipment, etc.) are not included in the counting. For example, if there are 10 pages of drawings and each drawing is split into 15 grids (5×3), there will be 150 potential grids to review. If a 20% sample rate is desired, then 30 grids would be reviewed, or every 5 grids. The starting grid should be chosen using a random selection process (die, 1-6 in a hat, etc.).
2. *Document Review Criteria:* The criteria from which to review the drawings should be based on specific Owner's Project Requirements criteria. This typically includes items such as accessibility, maintainability, meeting sustainability goals, comfort conditions, documentation of Owner's Project Requirements and Basis of Design, and operating details.
3. *Select Review Samples on Drawings:* Using the sampling strategy chosen in Step 1, mark the sample areas to be reviewed.
4. *Accomplish Detailed Statistical Review:* Using the review criteria from Step 2 and the selections from Step 3, accomplish a detailed review of the drawings. This includes verifying that the specifications match those shown on the drawings (see below for specification review details). For

example, if a VAV box is in the selected square, the steps in accomplishing the detailed review might include:

- (a) Review design calculation inputs for matching architectural assumptions and the Owner's Project Requirements.
 - (b) Compare calculation results with the total airflow of the diffusers downstream of the VAV box and with the VAV box schedule.
 - (c) Compare location of VAV box with maintenance requirements of the selected make and model (Basis of Design).
 - (d) Compare VAV box location on drawings with requirements in the specifications.
 - (e) Review the Owner's Project Requirements for other issues that the VAV box could impact.
5. *Document Concerns:* During the review of the drawings keep detailed notes of problems found or concerns with certain items. Also, at the end of the review, a general summary of the quality of the drawings should be developed. A letter detailing the quality of the drawings should then be sent to the design professionals and the owner with specific recommendations and directions given.
6. *Review the Drawing Review Procedure:* After the drawing review is completed, this document should be reviewed and modified to improve the process for the next time.

SPECIFICATION REVIEW

1. *Determine the Review Sampling Procedure:* The purpose of this review is to determine the general quality of the specifications. During the Field Specific Review the actual details are checked. The sampling procedure should check approximately 10% of the specifications. The easiest way of doing this is to check every x^{th} page of the specifications (i.e., if there are 100 pages, check every 10th page).
2. *Accomplish General Review:* The review should focus on the quality of the specification, specifically:
 - Are there extraneous sections that do not pertain to the project (i.e., medical gas in an office building, 15 types of valves when only 2 used, etc.)?
 - If a manufacturer has been listed, has the engineer checked to verify that the Owner's Project Requirements are met?
 - Are there any "or as equals"? ("As equal" should always be defined)
 - Are the directions clear and concise?
3. *Develop Summary of Review* – Develop a summary of the review. If there are problems with the specifications, contact the design professionals and discuss.

DESIGN PROFESSIONAL ACTIONS

Comments provided by the Commissioning Authority need to be formally replied to by the design professionals. If systemic issues are identified during the Commissioning Authority's review, the design process should be stopped and the issues resolved. It is expected at the next submission that the Commissioning Authority will again use random sampling

that will result in a review of different areas on the drawings and the specifications and that will identify whether the systemic issue has been resolved. Back-checking of the specific items may be appropriate, but not as the sole means of verifying resolution of the issue.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX O SYSTEMS MANUAL

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

Developing the Systems Manual encompasses gathering all of the information related to the systems, assemblies, and the Commissioning Process and incorporating it into a usable information resource with indexes and cross-references. This resource shall include the final Owner's Project Requirements, Basis of Design, the final Commissioning Plan, Commissioning Process Report, manufacturer installation manuals, manufacturer operations and maintenance manuals, system schematics, verified Record Drawings, and test results. This information is edited and organized to focus upon the key systems (roofing, walls, fire alarm, chilled water, hot water, etc.) in the building. Coordination with operations and maintenance personnel in developing standard formats and divisions (shops) is accomplished to simplify future Systems Manual development.

Also included in the Systems Manual is the development of periodic maintenance and information for insertion into a computer maintenance management system (CMMS), including equipment make and model information, checking requirements, maintenance requirements, and troubleshooting items.

The Commissioning Authority shall be responsible for verifying the development of the Systems Manual.

The entity responsible for developing the Systems Manual shall include all items involved in the project and capture the system and assembly data in either an electronic or printed version. In addition, printed operations, service, maintenance, spare parts list, and repair manuals may be provided. This entity (owner, contractor, design professional, other) shall have the skills of design, construction, and operations required to develop a cohesive Systems Manual.

The required details for a full Systems Manual are enhanced in each of the technical Commissioning Process Guidelines. The Systems Manual will have multiple sections depending upon the number of systems focused upon during the Commissioning Process. The Systems Manual will include a detailed table of contents with a notation as to resource storage location if not in the actual manual. The following outline is a recommended format:

1. General.

(a) Executive Summary (facility level).

This section includes an overall description of the building and its systems, including a listing of major capabilities and limitations imposed by the design or building code. The description should include type of facility, general description (number of floors, gross area, net area, type of occupancy, etc.), and general system descriptions. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information should be included in this section.

(b) Owner's Project Requirements (facility level).

A copy of the final Owner's Project Requirements for the facility is included in this section. This document was initially developed during the Pre-Design Phase and was updated throughout the project by the Owner, Commissioning Authority, or design professionals.

(c) Basis of Design (facility level).

This section includes the final Basis of Design document at a facility level. This document is written by the design professionals during the Design Phase and is updated by them to include any changes during the Construction Phase.

(d) Construction Record documents and specifications (not included in specific systems sections).

This section includes elements of the record set of Construction Documents (including specifications) that are not covered under specific systems—updated to reflect the final installation.

(e) Approved submittals (not included in specific system sections).

This section includes a copy of the approved submittals (not included under specific systems) with all field modifications and accessories clearly marked. In addition, the comments from original submittals shall be included.

(f) Facility operating procedures for all normal, abnormal, and emergency modes of operation (facility level).

This section includes detailed operating procedures for the facility during normal, abnormal, and emergency modes of operation. This is not intended to be automatic control sequences, but general operating procedures. This would include items such as building access during various situations (normal operation, after-hours operation, fire alarm, civil disturbance operation, emergency power operations, etc.).

(g) A list of recommended operational record keeping procedures at the facility level, including sample forms, trend logs, or others, and a rationale for each.

This section includes direction to the operation and maintenance personnel as to what information needs to be

documented and kept on the operation of the facility and why these records are important or will benefit the Owner or operations and maintenance personnel in the future.

(h) Maintenance procedures, schedules, and recommendations (facility level).

This section includes the manufacturer's recommendations for maintenance procedures and when maintenance should be performed on systems not included in specific system sections.

(i) Ongoing Optimization (facility level).

This section includes guidance for the ongoing optimization of the facility. Included in the section are schedules of periodic benchmarking using checklists and tests developed for the original construction, procedures for maintaining the Owner's Project Requirements and Basis of Design documents, and guidance on what to do when the Owner's Project Requirements are not achieved.

(j) Attachments:

Commissioning documents listing and storage location.

[The following section is completed for each system or assembly requiring operation and maintenance.]

2. xxx System/Assembly.

(a) Executive Summary (xxx System/Assembly).

This section includes a description of the systems/assemblies covered in this section, including a listing of capabilities and limitations imposed by the design or building code. The description should include type of system/assembly, general description, and schematics. A list of contractors, subcontractors, suppliers, and design professionals involved with this system along with their contact information should be included.

(b) Owner's Project Requirements (xxx System/Assembly level).

A copy of the final Owner's Project Requirements dealing with this system/assembly is included in this section. This document was initially developed during the Pre-Design Phase and was updated throughout the project by the Owner, Commissioning Authority, or design professionals.

(c) Basis of Design (xxx System/Assembly level).

This section includes the final Basis of Design document (including the design intent) as related to the specific systems included in this section. This document is typically written by the design professionals during the Design Phase and is updated by them to include any changes during the Construction Phase.

(d) Construction Record documents and specifications (xxx System/Assembly).

This section includes the record set of Construction Documents (including specifications) that has been updated to reflect the final installation of the specific system/assembly included in this section.

- (e) Approved submittals (xxx System/Assembly).

This section includes a copy of the approved submittals for the components associated with the system/assembly with all field modifications and accessories clearly marked. In addition, the comments from original submittals shall be included.

- (f) Operating procedures for all normal, abnormal, and emergency modes of operation (xxx System/Assembly).

This section includes detailed operating procedures for xxx systems/assemblies during normal, abnormal, and emergency modes of operation. This is not intended to be automatic control sequences, but general operating procedures.

- (g) A list of recommended operational record-keeping procedures, including sample forms, trend logs, or others, and a rationale for each (xxx System/Assembly).

This section includes direction to the operations and maintenance personnel as to what information needs to be documented and kept on the operation of the systems and why these records are important or will benefit the Owner or operations and maintenance personnel in the future.

- (h) Maintenance procedures, schedules, and recommendations (xxx System/Assembly).

This section includes the manufacturer's recommendations for maintenance procedures and when maintenance should be performed.

- (i) Ongoing optimization (xxx System/Assembly).

This section includes guidance for the ongoing optimization of the system/assembly. Included in the section are schedules of periodic benchmarking using checklists and tests developed for the original construction, procedures for maintaining the Owner's Project Requirements and Basis of Design documents, and guidance on what to do when the Owner's Project Requirements are not achieved.

- (j) Operations and maintenance manuals (xxx System/Assembly).

This section includes the manufacturer's printed operations and maintenance manuals for the specific equipment/components provided for the xxx system/assembly. Also included is a parts and recommended spare parts list, a troubleshooting guide for common situations, and one-line diagrams for each applicable system.

- (k) Training records (xxx System/Assembly).

This section includes information on training provided and attendees. In addition, information on ongoing training shall be provided.

- (l) Commissioning Process Report for xxx System/Assembly.

This section includes the Final Commissioning Process Report for the xxx system/assembly, including all test procedures, test results, and blank test forms.

(This annex is not part of this guideline. It is merely informative and does not contain requirements necessary for conformance to the guideline.)

INFORMATIVE ANNEX P TRAINING MANUAL AND TRAINING NEEDS

This annex provides an example of how to implement part of Guideline 0. It is not intended to be a comprehensive representation or a best practice example. Practitioners applying the Commissioning Process should carefully follow Guideline 0 and applicable commissioning technical guidelines tailored to their specific projects.

This annex is a collection of various requirements for training and identifies needs for the Training Manual. The Training Manual includes the Training Plan, which is composed of the Training Syllabus and Training Agenda that are provided to the contractor by the Owner with help from the CxA. The Training Manual also contains the results of training, including the Training Material and Training Evaluations completed by the Contractor. It is an example to provide direction, in that training needs vary substantially for each construction project or new building. The following is an example of a Training Manual outline or syllabus for the Training Manual with a focus on electrical and mechanical systems.

TRAINING SYLLABUS

Overview

This syllabus describes the objectives of the various sessions, lectures, and demonstrations that form a part of the training program developed for the Do-It-Right Building.

Sessions

There are two main sessions on the electrical systems and two main sessions on the mechanical systems that will provide training to the OK Service personnel. The first session will be conducted at the time of start-up and check-out and the second session will be about two months later. Sessions will be a minimum of two days duration for the basics in each system and be conducted as specified below. The sessions will be conducted at the site.

All training sessions will be visually recorded using either videotape (VHS format) or standard compact disk (CD) in PC format. The CD format is desired for longevity and keyword searching. The sessions can be recorded on videotape and then transferred to CDs.

A training agenda in the format enclosed will be provided for each session. This will be submitted three weeks prior to the scheduled training session. All listed owner's representatives will sign this prior to proceeding with the training.

A list of training topics that are appropriate for consideration are listed in the attached Training Agenda Topics list.

The Commissioning Authority will be notified of the scheduled training time and provided with a copy of the training material fifteen days prior to each training session. The Commissioning Authority will review the material and share

comments with the Owner and the design professionals. If any aspects do not meet the requirements of the specifications, this will be communicated through the design professionals. The Commissioning Authority will attend 25% or more of the training sessions.

A receipt acknowledging completion of each item of instruction will be secured.

The training will be evaluated based upon the criteria in the attached evaluation form.

Electrical Systems

The training shall include:

- General familiarization and operating procedures for the entire electrical installation.
- Routine maintenance procedures for equipment.
- Specific operating and maintenance procedures for:
 - Switchboards
 - Emergency power supply system
 - Fire alarm system

Factory-trained technicians will provide operating and maintenance instructions on the following:

| System/Equipment | Minimum Session Duration, hours |
|---------------------------------------|---------------------------------|
| Emergency power supply system | x |
| Fire alarm system | x |
| Lighting control systems | x |
| Switchboards | x |
| Medium voltage pad-mounted switchgear | x |

Mechanical Systems

The training shall include:

- General familiarization with and operating procedures for the entire plumbing, laboratory gas, pure water, compressed air, fuel, HVAC&R, and fire protection systems installation.
- Routine maintenance procedures for equipment.
- Specific operating and maintenance procedures for:
 - Hot water system consisting of boilers, pumps, controls, and hydronic specialties.

- Chilled water systems consisting of chillers, cooling towers, pumps, controls, and hydronic specialties.
- Automatic temperature control system consisting of all associated hardware, software, and program logic; this is to be arranged by systems.
- Laboratory air-side control system consisting of supply, hood, and general exhaust valves, reheat coils, and room control panel.
- Clean agent fire suppression systems, including emergency procedures, abort functions, and safety requirements.
- Laboratory hood exhaust air system.

Factory-trained technicians will give instruction on the following specialty systems and equipment:

| System/Equipment | Minimum Session Duration, hours |
|--------------------------------|---------------------------------|
| Variable speed drives | x |
| Chillers | x |
| Automatic temperature controls | x |
| Water treatment systems | x |
| Laboratory control systems | x |

DDC System

There will be two formal training sessions on the DDC system. Each of the sessions will be conducted by factory-trained personnel for a minimum duration of xx 8-hour days. Materials and training will be provided for up to xx operators per session (selected by the Owner).

There will be a separate training course provided on the DDC system for supervisory personnel. This training will briefly cover the material of the operator training session but will be focused on the more advanced features of the system with emphasis on the energy conservation strategies and reporting capabilities of the system and how to implement them. The training session will be conducted by factory-trained personnel for a minimum duration of xx 8-hour days, for a total of xx training hours. Materials and training will be provided for up to xx persons selected by the Owner.

TRAINING AGENDA

| | |
|---------------------------|--|
| Project: | Do-It-Right—Wonderful Sky Building |
| Training Material: | Systems Manual; Evaluation Forms; Record Forms; Specification Sections, Miscellaneous Manufacturer's Documentation, Field Equipment (for demonstrations) |

SECTION 1. AUDIENCE AND GENERAL SCOPE

Intended audience type: ☒ O&M Staff, ☒ Supervisory Personnel
☒ Laboratory Users ☒ _____
 General scope of training: ☐ A. Overview ☒ B. Intermediate ☒ C. Detailed

SECTION 2. INSTRUCTORS

| ID | Instructor (Factory Trained) | Company |
|----|------------------------------|---------|
| 1) | _____ | _____ |
| 2) | _____ | _____ |
| 3) | _____ | _____ |
| 4) | _____ | _____ |
| 5) | _____ | _____ |

SECTION 3. AGENDA

SESSION A – ELECTRICAL AND FIRE PROTECTION SYSTEMS

| | Lectures/Demonstrations | Dates | Location | Duration (hr x freq*) | Instructor ID(s) |
|----|---|-------|----------|--------------------------|---------------------|
| A1 | Emergency power supply system | _____ | _____ | 8 x 2 | _____ |
| A2 | Fire alarm system | _____ | _____ | 8 x 2 | _____ |
| A3 | Lighting control | _____ | _____ | 4 x 2 | _____ |
| A4 | Switchboards | _____ | _____ | 4 x 2 | _____ |
| A5 | Medium voltage pad-mounted switchgear | _____ | _____ | 4 x 2 | _____ |
| A6 | O&M procedures for clean agent fire suppression systems, including emergency procedures, abort functions, and safety requirements | _____ | _____ | 4 x 2 | _____ |

Total duration of training (h) ----->

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SESSION B – MECHANICAL AND PLUMBING SYSTEMS

| | Lectures/Demonstrations | Dates | Location | Duration (hr x freq*) | Instructor ID(s) |
|----|---|-------|----------|--------------------------|---------------------|
| B1 | Variable speed drives | _____ | _____ | 4 x 2 | _____ |
| B2 | Chillers | _____ | _____ | 4 x 2 | _____ |
| B3 | General familiarization and operating procedures for plumbing equipment | _____ | _____ | 3 x 2 | _____ |
| B4 | Water treatment systems | _____ | _____ | 2 x 2 | _____ |

Total duration of training (h) ----->

26

SESSION C – CONTROL SYSTEM

| Lectures/Demonstrations | Dates | Location | Duration (hr x freq) | Instructor ID(s) |
|--|-------|----------|-------------------------|---------------------|
| C1 Laboratory control systems | _____ | _____ | 8 × 2* | _____ |
| C2 Automatic temperature controls | _____ | _____ | 10 × 2* | _____ |
| C3 DDC system operations (for up to xx operators) | _____ | _____ | 32 × 2* | _____ |
| C4 DDC system emphasis on advanced features of system, energy conservation strategies, and reporting capabilities and how to implement them (for up to xx supervisors) | _____ | _____ | 16 × 1 | _____ |

Total duration of training (h) ----->

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* Frequency is 2 formal training sessions as per spec. sections 15900, pg. 16, Part 2.1, and 16800, pg. 5, Part 7.3. The first session shall be conducted at the time of start-up and check-out and the second session shall be approximately 2 months later.

SECTION 4. APPROVALS

This Training Program has been approved by the following individuals, subject to any additions and clarifications noted.
(This is not an approval of training completion.)

Do-It-Right, Inc. Representative

Date

Commissioning Authority

Date

TRAINING AGENDA TOPICS

(Suggested General Topics to Be Included)

| Suggested List of Subjects | | Requested by D-I-R, Inc. (✓) | Desired Duration (h) |
|--|---|------------------------------------|----------------------------|
| 1. | Overview and description of the purposes of the system | | |
| 2. | System troubleshooting: description of diagnostic step-by-step procedures for determining the source of problems on the system level; review technical service manual in detail | | |
| 3. | Component maintenance: instruction of required procedures for weekly, monthly, and annual preventive checks and timely repairs to preserve system integrity | | |
| 4. | Component troubleshooting: description of diagnostic procedures for determining the source of problems on the component level | | |
| 5. | Review of control drawings and schematics (have copies for attendees) | | |
| 6. | Startup, loading, normal operation, unloading, shutdown, unoccupied operation, seasonal changeover, etc., as applicable | | |
| 7. | Integral controls (packaged): programming, troubleshooting, alarms, manual operation | | |
| 8. | Building automation system (BAS) controls: programming, troubleshooting, alarms, manual operation, interface with integral controls | | |
| 9. | Interactions with other systems, operation during power outage and fire | | |
| 10. | Relevant health and safety issues and concerns and special safety features | | |
| 11. | Energy-conserving operation and strategies | | |
| 12. | Any special issues to maintain warranty | | |
| 13. | Common troubleshooting issues and methods, control system warnings and error messages, including using the control system for diagnostics | | |
| 14. | Special requirements of tenants for this equipment's function | | |
| 15. | Service, maintenance, and preventive maintenance (sources, spare parts inventory, special tools, etc.) | | |
| 16. | Question and Answer Period | | |
| Total hours requested | | | |
| Total hours required by specifications | | | |

Training Evaluation

Session: _____

Date: _____

Location: _____

Purpose: This form is used to evaluate each training session. Based upon this evaluation, later sessions can be improved. This form will be completed by the Commissioning Authority and one D-I-R employee in the training session after each session.

Every attendee fills out one copy of this form. Mark questions that are not applicable with N/A.

| 1 = very well to 5 = not at all | | | | | | |
|---|---|---|---|---|---|-----|
| 1. How were the objectives of this training session met? | 1 | 2 | 3 | 4 | 5 | N/A |
| 2. Do you know where the components/systems are located? | 1 | 2 | 3 | 4 | 5 | N/A |
| 3. Do you know what area the components/systems are serving? | 1 | 2 | 3 | 4 | 5 | N/A |
| 4. Do you understand the various types and purpose of these components/systems? | 1 | 2 | 3 | 4 | 5 | N/A |
| 5. Do you understand/know how to systematically troubleshoot common problems with these components/systems? | 1 | 2 | 3 | 4 | 5 | N/A |
| 6. Do you know how the components/systems operate under all normal modes? | 1 | 2 | 3 | 4 | 5 | N/A |
| 7. How well do you understand the importance of meeting the design intent for the systems covered? | 1 | 2 | 3 | 4 | 5 | N/A |
| 8. Are you able to efficiently find the relevant information in the Systems Manual to operate and maintain the systems/components you were trained for in this session? | 1 | 2 | 3 | 4 | 5 | N/A |
| 9. Do you know how to perform the needed maintenance on the equipment and/or do you know to get the information you need? | 1 | 2 | 3 | 4 | 5 | N/A |
| 10. Do you know how to get updated technical service information for the components/systems? | 1 | 2 | 3 | 4 | 5 | N/A |

Explain why any questions got very low or very high ratings from you:

What topics would you desire to be covered that were absent from this training session?

You may provide other comments concerning anything about this training session (e.g., information prior to training, content):

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 070150.19 "Preparation for Reroofing" for impacted areas of the roofing membrane.

1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Vose Elementary School
1. Inspect and discuss condition of construction to be selectively demolished.
 2. Review structural load limitations of existing structure.
 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 3. Coordination for shutoff, capping, and continuation of utility services.
 4. Coordination of Owner's continuing occupancy of portions of existing building.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 FIELD CONDITIONS

- A. Owner may occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

SELECTIVE DEMOLITION

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1. Before selective demolition, Owner will remove the following items:
 - a. Classrooms, library, and computer lab will be emptied of all loose furnishings, furniture, and equipment prior to Contractor mobilization.
 - C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
 - D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- 1.8 WARRANTY
- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
 1. TPO Roofing Membrane
 - B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.
- 1.9 COORDINATION
- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

SELECTIVE DEMOLITION

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

SELECTIVE DEMOLITION

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- a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
- b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
- c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
- d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
 6. Maintain adequate ventilation when using cutting torches.
 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area as designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- C. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. New roofing materials to match roofing materials on existing building.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

1.1 RELATED DOCUMENTS

- A. Drawings and general 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. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

- B. Related Requirements:

- 1. Division 32 for concrete pavement and walks.
 - 2. Section 072600 "Vapor Retarders"

1.3 DEFINITIONS

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

- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
 - 2. Review the following:

- a. Special inspection and testing and inspecting agency procedures for field quality control.
- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
5. Color pigments.
6. Fiber reinforcement.
7. Vapor retarders.
8. Floor and slab treatments.
9. Liquid floor treatments.
10. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
11. Joint fillers.
12. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Synthetic micro-fiber content.
10. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
11. Intended placement method.
12. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.

D. Samples: For vapor retarder.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Testing agency: Include copies of applicable ACI certificates.

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

1. Cementitious materials.
2. Admixtures.

3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

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

1. Portland cement.
2. Fly ash.
3. Aggregates.
4. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. 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. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
 - 3. Do not use frozen materials or materials containing ice or snow.

4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301 (ACI 301M).

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
- B. Form Liners: Units of face design, texture, arrangement, and configuration to match those used for precast concrete sandwich panels on existing school. Use with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect cast-in-place concrete surfaces and does not impair subsequent surface or joint treatments of cast-in-place concrete.

1. Form liners basis of design: Fitzgerald GrayLastic Pattern 16927 Grape Stake and Pattern 16938 Random Plank.
 2. Form liner must match existing school façade.
- C. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

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

2.5 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
2. Obtain aggregate from single source.
3. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I or Type II
2. Fly Ash: ASTM C618, Class C or F.

C. Normal-Weight Aggregates: ASTM C33/C33M, coarse aggregate or better, graded. Provide aggregates from a single source.

1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).
2. Maximum Coarse-Aggregate Size: 1-inch or 1-1/2 inches (38 mm) nominal.
3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
7. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494/C494M, Type C.
8. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

- a. Ambient Temperature Below 50 deg F (10 deg C): Black.
- b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
- c. Ambient Temperature Above 85 deg F (29 deg C): White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Floor Slab Protective Covering: Eight-feet- (2438-mm-) wide cellulose fabric.
- F. Exterior expansion joints adjacent to vertical surfaces
 - 1. Approved Product (or equal): Polyblend Sanded Grout, color to match concrete

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 5,000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch (6 mm) and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301 (ACI 301M).

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash or Other Pozzolans: 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2.10 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings and foundation walls
 1. Exposure Class: ACI 318 (ACI 318M) F1
 2. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
 3. Maximum w/cm: 0.45
 4. Slump Limit: 8 inches (200 mm), plus or minus 1 inch (25 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 at Project site
 5. Air Content:
 - a. Exposure Class F1: 4.5 percent, plus or minus 1.5 percent, at point of delivery for concrete containing 1-inch (25-mm) or 1-1/2-inch (38-mm) nominal maximum aggregate size
 6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- B. Class B: Normal-weight concrete used for interior slabs-on-ground.
 1. Exposure Class: ACI 318 (ACI 318M) F0
 2. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 3. Maximum w/cm: 0.50
 4. Minimum Cementitious Materials Content: Comply with ACI 30. 470 lb/cu. yd. (279 kg/cu. m)] for 1 1/2-inch maximum aggregate. 520 lb/cu. yd. (309 kg/cu. m) for 1-inch aggregate.
 5. Slump Limit: 8 inches (200 mm), plus or minus 1 inch (25 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 at Project site.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

7. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

C. Class C: Normal-weight concrete used for exterior slabs-on-ground.

1. Exposure Class: ACI 318 (ACI 318M) F2
2. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.
3. Maximum w/cm: 0.45
4. Slump Limit: 8 inches (200 mm), plus or minus 1 inch (25 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 at Project site
5. Air Content:
 - a. Exposure Class F2: 6.0 percent, plus or minus 1.5 percent, at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size. 5.5 percent, plus or minus 1.5 percent, at point of delivery for concrete containing 1-1/2-inch (38-mm) nominal maximum aggregate size
6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.11 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.

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3. Secure facilities for storage, initial curing, and field curing of test samples, including continuous electrical power.
4. Security and protection for samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF 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.
 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 4. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
 1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).

- a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.
 6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1 inch (25 mm).
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
 - e. Apply to concrete surfaces not exposed to public view
2. ACI 301 (ACI 301M) Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
 - b. Remove projections larger than 1/8 inch (3 mm).
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
2. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish:
 - a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
 - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - c. Wet concrete surfaces.
 - d. Compress grout into voids by grinding surface.
 - e. In a swirling motion, finish surface with a cork float.
- C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
 1. Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi (13.8 MPa).
 2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
 3. Surface Continuity:
 - a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match field samples.
 4. Abrasive Blasting:

- a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
- b. Determine type of nozzle pressure and blasting techniques required to match field sample.
- c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Medium Texture: Generally, expose coarse aggregate with slight reveal and with a maximum reveal of 1/4 inch (6 mm).

D. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

7. Finish surfaces to the following tolerances, in accordance with ASTM E1155 (ASTM E1155M), for a randomly trafficked floor surface:

- a. Slabs on Ground:

- 1) Specified overall values of flatness, F_F 35; and of levelness, F_L 25; with minimum local values of flatness, F_F 24; and of levelness, F_L 17.

8. Finish and measure surface, so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm).

- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

- C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4500 psi (31 MPa) at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
 6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
 2. Screed, tamp, and trowel finish concrete surfaces.

3.9 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
 2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply in accordance with manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 3. If forms remain during curing period, moist cure after loosening forms.
 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.

- c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
- d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
- e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

D. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:

- 1. Begin curing immediately after finishing concrete.
- 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.

- 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
- 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
- 4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

- 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
- 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches (150 mm) and sealed in place.
- 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
- 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.10 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch (19 mm).
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete.

- a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar.
- a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 2. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.

- 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with 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 provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M:
 - a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
 3. Slump Flow: ASTM C1611/C1611M:

- a. 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.
 - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast, initial cure, and field cure two sets of four standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. 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.
9. 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.
10. 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 (3.4 MPa).
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:
 - a. 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.

- b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 (ACI 301M), section 1.6.6.3.
- 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 (ASTM E1155M) within 72 hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

- A. Protect concrete surfaces as follows:
 - 1. Protect from petroleum stains.
 - 2. Diaper hydraulic equipment used over concrete surfaces.
 - 3. Prohibit vehicles from interior concrete slabs.
 - 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 - 5. Prohibit placement of steel items on concrete surfaces.
 - 6. Prohibit use of acids or acidic detergents over concrete surfaces.
 - 7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
 - 8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes polished concrete finishing and scoring
 - 1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.3 DEFINITIONS

- A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Cast-in-place concrete subcontractor.
 - c. Polished concrete finishing Subcontractor.
 - 2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete finishing, and protection of polished concrete.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Liquid floor treatments.

1.7 QUALITY ASSURANCE

- A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches (1200 by 1200 mm) minimum, to demonstrate the expected range of finish, color, and appearance variations.

1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

PART 3 - EXECUTION

3.1 POLISHING

- A. Polish: Match finish in existing school. Finish is to be Grade 1 with a Class 2, 800 grit polish.

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- B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
1. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match floor surfaces in existing school.
 2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
 3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 4. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match concrete finish in existing school.
 5. Control and dispose of waste products produced by grinding and polishing operations.
 6. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Structural steel.
 - 2. Shrinkage-resistant grout.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches (38 mm).
 - 2. Welded built-up members with plates thicker than 2 inches (50 mm).
 - 3. Column base plates thicker than 2 inches (50 mm).
- D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Anchor rods.
 - 4. Threaded rods.
 - 5. Shop primer.
 - 6. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment Drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 - 5. Identify members and connections of the seismic-load-resisting system.
 - 6. Indicate locations and dimensions of protected zones.
 - 7. Identify demand-critical welds.
 - 8. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing including the following:
 - 1. Power source (constant current or constant voltage).
 - 2. Electrode manufacturer and trade name, for demand-critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, and testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
- F. Source quality-control reports.
- G. Field quality-control reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 1. ANSI/AISC 303.
 2. ANSI/AISC 341.
 3. ANSI/AISC 360.
 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Wood Shear wall system

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M
- B. Channels, Angles Shapes: ASTM A36/A36M
- C. Plate and Bar: ASTM A36/A36M, ASTM A572/A572M, Grade 50 (345) where designated as Grade 50.
- D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M Grade C or ASTM A1085/ASTM A1085M structural tubing.
- E. Welding Electrodes: E70XX minimum. Comply with AWS requirements.

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2.3 BOLTS AND CONNECTORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain

2.4 RODS

- A. Unheaded Anchor Rods: ASTM F1554, Grade 55, weldable

1. Configuration: Straight
2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
5. Finish: Plain

- B. Headed Anchor Rods: ASTM F1554, Grade 55, weldable

1. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
4. Finish: Plain

2.5 PRIMER

- A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.6 SHRINKAGE-RESISTANT GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.

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2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces unless indicated to be painted.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 2.
 2. SSPC-SP 3.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage Engage a qualified testing agency to perform shop tests and inspections.
1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.

- d. Radiographic Inspection: ASTM E94/E94M.
- 4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
 - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 - 1. Joint Type: Snug tightened
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.

3.6 PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION 051200

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior non-load-bearing wall framing.
 - 2. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
 - 3. Soffit framing.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
 - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
 - 3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings:

- 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
 - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

- C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Product Certificates: For each type of code-compliance certification for studs and tracks.
- D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - 1. Steel sheet.
 - 2. Expansion anchors.
 - 3. Power-actuated anchors.
 - 4. Mechanical fasteners.
 - 5. Vertical deflection clips.
 - 6. Horizontal drift deflection clips
 - 7. Miscellaneous structural clips and accessories.
- E. Evaluation Reports: For nonstandard cold-formed steel framing, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ClarkDietrich Building Systems.
 2. Nuconsteel, A Nucor Company.
 3. SCAFCO Corporation.
 4. Steel Construction Systems.
 5. Steel Network, Inc. (The).
 6. Steel Structural Systems.
 7. Steeler, Inc.
 8. United Metal Products, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Drawings.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
 - b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
 - c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 3/4 inch (19 mm).

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
 1. Floor and Roof Systems: AISI S210.
 2. Wall Studs: AISI S211.
 3. Headers: AISI S212.
 4. Lateral Design: AISI S213.
- D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
 1. Grade: As required by structural performance.
 2. Coating: G60 (Z180).
- C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
 1. Grade: As required by structural performance.
 2. Coating: G60 (Z180).

2.4 FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: As required by structural performance.
 2. Flange Width: 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: As required by structural performance.

2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 1. Minimum Base-Metal Thickness: 0.05 inch (1.27 mm).
 2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.05 inch (1.27 mm).
 2. Flange Width: 1-5/8 inches (41 mm).
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 1. Minimum Base-Metal Thickness: 0.05 inch (1.27 mm).
 2. Flange Width: 1-1/4 inches (32 mm).
- C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 1. Minimum Base-Metal Thickness: 0.05 inch (1.27 mm).
 2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

- E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.05 inch (1.27 mm).
 - 2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.7 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers and knee braces.
 - 9. Joist hangers and end closures.
 - 10. Hole-reinforcing plates.
 - 11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.
- C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
 2. Type: Torque-controlled expansion anchor or adhesive anchor.
 3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.
- F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780/A 780M.
- B. Cement Grout: Portland cement, ASTM C 150/C 150M, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C 1107/C 1107M, and with a fluid consistency and 30-minute working time.
- D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.10 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
1. Fabricate framing assemblies using jigs or templates.
 2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.
- C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

- C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.
- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.
 - 2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

- H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed steel framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.

- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: As indicated on Drawings.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Connect vertical deflection clips to studs and anchor to building structure.
 - 4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - 1. Install solid blocking at centers indicated on Shop Drawings.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 JOIST INSTALLATION

- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
- B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections.
- C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated on Drawings.
- D. Frame openings with built-up joist headers, consisting of joist and joist track or another combination of connected joists if indicated.
- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Joist-Track Solid Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Combination Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.7 ERECTION TOLERANCES

- A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Field and shop welds will be subject to testing and inspecting.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Shelf angles.
6. Miscellaneous steel trim including steel angle corner guards.
7. Metal bollards.
8. Downspout guards.
9. Abrasive metal nosings, treads and thresholds.
10. Metal downspout boots.

- B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

- C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 051200 "Structural Steel Framing".
3. Section 055213 "Pipe and Tube Railings".

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
 - 2. Prefabricated building columns.
 - 3. Metal nosings and treads.
 - 4. Paint products.
 - 5. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Steel framing and supports for operable partitions.
 - 2. Steel framing and supports for countertops.
 - 3. Steel framing and supports for mechanical and electrical equipment.
 - 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 5. Elevator machine beams, hoist beams, and divider beams.
 - 6. Metal bollards.
 - 7. Abrasive metal nosings, treads and thresholds.
 - 8. Loose steel lintels.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- D. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

METAL FABRICATIONS

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2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
 - 3. Provide stainless-steel fasteners for fastening nickel silver.
 - 4. Provide bronze fasteners for fastening bronze.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
 - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide product compatible with system as required per Sections 099113 "Exterior Painting," 099123 "Interior Painting," as appropriate for location and painting system indicated.

- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
 - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with high performance primer.

2.7 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.

2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize and prime shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with high performance primer.

2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 40 steel pipe unless indicated otherwise.
 1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.

2.10 DOWNSPOUT GUARDS

- A. Fabricate downspout guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.
- B. Galvanize and prime downspout guards.

2.11 ABRASIVE METAL NOSINGS, TREADS AND THRESHOLDS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Nosings: Cross-hatched units, 4 inches (100 mm) wide with 1-inch (25-mm) lip, for casting into concrete.
 2. Nosings: Cross-hatched units, 1-1/2 by 1-1/2 inches (38 by 38 mm), for casting into concrete.
 3. Treads: Cross-hatched units, full depth of tread with 3/4-by-3/4-inch (19-by-19-mm) nosing, for application over bent plate treads or existing stairs.
 4. Thresholds: Fluted-saddle-type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with tapered edges.
 5. Thresholds: Fluted-interlocking- (hook-strip-) type units, 5 inches (125 mm) wide by 5/8 inch (16 mm) high, with tapered edge.
 6. Thresholds: Plain-stepped- (stop-) type units, 5 inches (125 mm) wide by 1/2 inch (12 mm) high, with 1/2-inch (12-mm) step.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.
- D. Apply bituminous paint to concealed surfaces of cast-metal units.

2.12 METAL DOWNSPOUT BOOTS

- A. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
1. Outlet: Vertical, to discharge into pipe.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.16 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with primers specified in Section 099113 "Exterior Painting", primers specified in Section 099123 "Interior Painting"
- D. Preparation for Shop Priming: Clean surfaces to be painted per primer manufacturer's written instructions. Remove loose rust and mill scale and other spatter, slag, flux deposits, and any other potential bond-breaking materials.
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - 1. Cast Aluminum: Heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 INSTALLING PIPE GUARDS

- A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.5 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.
- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." and Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

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BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
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END OF SECTION 055000

METAL FABRICATIONS

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SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel pipe and tube railings.
 - 2. Stainless-steel pipe and tube railings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connecting and finishing members at intersections.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Pisor Industries, Inc.
 2. Sharpe Products.
 3. Standard Steel Fabricating Co., Seattle, WA
 4. Totem Steel Fabricators, Inc., Woodinville, WA.
 5. Wagner, R & B, Inc.; a division of the Wagner Companies.
 6. Welding Fabrication, LLC, Auburn, WA.
 7. Source Limitations: Obtain each type of railing from single
- B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C, material surfaces

2.3 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 1. Style Designation: Per drawings
- D. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, pattern and thickness per drawings.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
 - 4. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
 3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1 stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
1. For aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide product compatible with system as required per Sections 099113 "Exterior Painting," 099123 "Interior Painting," for location and painting system indicated.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- H. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- I. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- L. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
 3. Remove flux immediately.
 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form Changes in Direction as Follows:
1. As detailed.
 2. By flush bends or by inserting prefabricated flush-elbow fittings.
- K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.
- Q. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch (1.1 mm) thick, unless shown otherwise on drawings.
 2. Orient expanded metal as indicated on Drawings.

- R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.
- S. Steel Grating: For infill panels, treads and risers as shown on drawings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

- E. Preparation for Shop Priming: Clean surfaces to be painted per primer manufacturer's written instructions. Remove loose rust and mill scale and other spatter, slag, flux deposits, and any other potential bond-breaking materials.

- F. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

- G. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer

2. Do not apply primer to galvanized surfaces.
3. Color: As selected by Architect from manufacturer's full range.

2.9 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

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- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
 - 2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

- C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
 - 6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting".
- D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Rooftop equipment bases and support curbs.
 - 2. Wood blocking, cants, and nailers.
 - 3. Wood furring and grounds.
 - 4. Wood sleepers.
 - 5. Plywood backing panels.

- B. Related Requirements:

- 1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment".
 - 2. Section 062023 "Interior Finish Carpentry".
 - 3. Section 075423 "Thermoplastic polyolefin (TPO) roofing".
 - 4. Section 076200 "Sheet metal flashing and trim".

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater size but less than 5 inches nominal (114 mm actual) size in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include

physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.6 QUALITY ASSURANCE

- ### A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- ### A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- ### A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Dress lumber, S4S, unless otherwise indicated.

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- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Treatment shall not promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Cants.
 5. Furring.
 6. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
- C. Concealed Boards: 15 percent maximum moisture content of the following species and grades:
1. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWP.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.7 METAL FRAMING ANCHORS

- A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- B. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire

- blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- 3.2 WOOD BLOCKING AND NAILER INSTALLATION
- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
 - B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall sheathing.
 - 2. Parapet sheathing.
 - 3. Sheathing joint and penetration treatment.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
 - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
 - 4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that

periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Dens-Glass Gold by G-P Gypsum Corporation, or comparable product by, but not limited to, one of the following:
 - a. American Gypsum.
 - b. LaFarge North America Inc.
 - c. National Gypsum Company.
 - d. Temple-Inland Inc.
 - e. United States Gypsum Co.
 - 2. Type and Thickness: Regular, 1/2 inch thick.
 - 3. Size: 48 by 96 inches for vertical installation.

2.3 PARAPET SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide Dens-Glass Gold by G-P Gypsum Corporation, or comparable product by, but not limited to, one of the following:
 - a. American Gypsum.

- b. LaFarge North America Inc.
 - c. National Gypsum Company.
 - d. Temple-Inland Inc.
 - e. United States Gypsum Co.
2. Type and Thickness: Regular, 1/2 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

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- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
- D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- E. Coordinate parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.
 - 1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 - 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.
 2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- E. Seal sheathing joints according to sheathing manufacturer's written instructions.
1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior MDF paneling (MDF-#).

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view, and equipment backup panels.
 - 2. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry for opaque finishes.
 - 3. Color and Finish Schedule on the Drawings.

1.3 DEFINITIONS

- A. WI – Woodwork Institute; <http://woodworkinstitute.com>; 916-372-9943.
- B. NAAWS - Definitions in the "North American Architectural Woodwork Standards" (NAAWS), latest edition, apply to the Work of this Section. 3.1 or latest edition, jointly published by the Woodwork Institute (WI) and the Architectural Woodwork Manufacturers Association of Canada (AWMAC)
 - 1. For free downloads in PDF format, www.naaws-committee.com.
- C. CCP – Certified Compliance Program. <https://woodworkinstitute.com/services/certified-compliance-program/>.

1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

1.5 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
- B. Samples for Verification:
 - 1. For each species and cut of lumber products with nonfactory-applied finish, with half of exposed surface finished, 50 sq. in. for lumber.
 - 2. For each finish system and color of lumber products with factory-applied finish, 50 sq. in. for lumber.
- C. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Fabricator and Installer Qualifications: Employs skilled workers who fabricate and install products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in WI's Quality Certification Program.
 - 1. Woodwork manufacturers and installers do not need to be members of WI nor an Accredited Millwork Company (AMC) for their work product to be inspected and certified in compliance with the NAAWS. It is the achievement of compliance with the standards on each project and not prior membership that is of paramount necessity.
 - 2. The woodwork manufacturer must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this project.
- B. Installer Qualifications: Certified participant in WI's Quality Certification Program.
- C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- D. Mockups: Build sample mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

- E. At completion of installation, provide a Woodwork Institute Certified Compliance Certificate indicating the products installed and certifying that the installation of these products fully meets the requirements of the grade or grades specified.
- F. All fees charged by the Woodwork Institute for its Certified Compliance program are the responsibility of the millwork manufacturer and/or installer and shall be included in their bid as a line item in the Scope of Work to be later billed to the project owner.
- G. Overage: Ensure appropriate amount of overage to account for quality requirement; for all WD-# types allow for approximately 25 percent additional materials to allow sorting and rejecting to meet quality requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of the NAAWS Section 2 Care and Storage.
- B. Stack lumber flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- C. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period. Maintain temperature and relative humidity during remainder of construction period in range recommended for Project location by the "North American Architectural Woodwork Standards."
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "North American Architectural Woodwork Standards" for grades of interior finish carpentry indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from WI's certification program indicating that woodwork, including installation, complies with requirements of grades specified.
 - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.2 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's Board of Review. Grade lumber by an agency certified by the American Lumber Standard Committee's Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Softwood Plywood: DOC PS 1.
- C. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.

- C. For exposed items indicated to receive a stained or natural finish, use organic resin chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.
- D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.
- E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.
 - 2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
- F. Medium Density Fiberboard, (MDF-1):
 - 1. Basis-of-Design Product: Medex moisture-resistant MDF by Roseburg Lumber; www.roseburg.com.
 - 2. Material Standard: ANSI A208.2, with formaldehyde-free adhesive system.
 - 3. Size Thickness: As specified in Color and Finish Schedule on Drawings.
 - 4. Finish: As specified in Color and Finish Schedule on Drawings.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- D. Multipurpose Construction Adhesive: Formulation complying with ASTM D3498 that is recommended for indicated use by adhesive manufacturer.

2.5 FABRICATION

- A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
 - 1. Interior standing and running trim, except shoe and crown molds.

- B. Ease edges of lumber less than 1-inch in nominal thickness to 1/16-inch radius and edges of lumber 1-inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 - 4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

3.5 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

- A. Clean interior finish carpentry on exposed and semi-exposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes if any.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 070150.19 - PREPARATION FOR REROOFING

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Additional Related Sections
 - 1. 017300 Execution.
 - 2. 075423 Thermoplastic Polyolefin (TPO) Roofing.

1.2 SUMMARY

- A. Section Includes:
 - 1. Patching and work at new mechanical rooftop unit curbs.
 - 2. Temporary roofing.
 - 3. Protection of existing roof at area of work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
 - 1. Include certificate that Installer is approved by warrantor of existing roofing system.

1.4 CLOSEOUT SUBMITTALS

- A. Certified statement from Carlisle stating that existing roof warranty has not been affected by Work performed under this Section.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.

1.6 FIELD CONDITIONS

- A. Existing Roofing System: Roof was built in 2017 with a Carlisle product fully adhered elastic sheet membrane over original asphalt built-up roofing. Contractor to field verify. See assembly notes in drawings.

- B. Owner will not occupy portions of building immediately below reroofing area.
 - 1. Conduct reroofing so Owner's operations are not disrupted.
 - 2. Provide Owner with not less than 48 hours' written notice of activities that may affect Owner's operations.
 - 3. Coordinate work activities daily with Owner so Owner has adequate advance notice to place protective dust and water-leakage covers over sensitive equipment and furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below work area.
 - 4. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below affected area.
 - a. Verify that occupants below work area have been evacuated before proceeding with work over impaired deck area.
- C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- E. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
 - 1. Record Drawings for existing roofing system can be provided for Contractor's convenience and information, but they are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.
- F. Limit construction loads on existing roof areas to remain, and existing roof areas scheduled to be reroofed for rooftop equipment wheel loads and for uniformly distributed loads.
- G. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
 - 1. Remove only as much roofing in one day as can be made watertight in the same day.
- H. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. Existing roof will be left no less watertight than before removal.
 - 3. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
 - a. Hazardous materials will be removed by Owner under a separate contract.

1.7 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty issued by Carlisle.
 - 1. Notify warrantor before proceeding with the Work.
 - 2. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect.
 - a. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

- A. EPS Insulation: ASTM C578.
- B. Plywood: DOC PS 1, Grade CD, Exposure 1.
- C. OSB: DOC PS 2, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

- A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

2.3 INFILL AND REPLACEMENT MATERIALS

- A. Use infill materials matching existing roofing system materials unless otherwise indicated.
- B. Steel deck is to match existing and to be reviewed by structural engineer.
- C. Wood blocking, curbs, and nailers are specified in "061053 Miscellaneous Rough Carpentry".
- D. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:

PREPARATION FOR REROOFING

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1. Protect existing roofing system that is not to be reroofed.
2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
4. Comply with requirements of existing roof system manufacturer's warranty requirements.

END OF SECTION 070150.19

SECTION 071113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied, emulsified-asphalt dampproofing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials. Manufacturers to consider including the following:
 - 1. BASF
 - 2. Tremco

- B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Trowel Coats: ASTM D 1227, Type II, Class 1.
- B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- D. Patching Compound: As recommended in writing by dampproofing manufacturer.
- E. Protection Course: ASTM D 6506, 1/8-inch- (3-mm-) thick, semirigid sheets of fiberglass or mineral-reinforced-asphaltic core, pressure laminated between two asphalt-saturated fibrous liners.

2.4 MOLDED-SHEET DRAINAGE PANELS

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core; and with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.

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- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
 - 1. Extend dampproofing 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Foundations and Parged Masonry Foundation Walls: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

- B. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m) or primer and one trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).
- C. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).
- D. Unexposed Face of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

3.5 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 - 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.
 - 2. Install protection course within 24 hours of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall substrate, according to manufacturer's written instructions. Use adhesives or other methods that do not penetrate dampproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. Install protection course before installing drainage panels.

3.7 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 071700 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Bentonite waterproofing.
 - 2. Molded-sheet drainage panels.
- B. Related Requirements:

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and installation instructions.
- B. Shop Drawings: Include installation details for waterproofing, penetrations, and interface with other work.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of waterproofing material.
- B. Preconstruction Test Reports: For water samples taken at Project site along with recommendations resulting from these tests.
- C. Sample Warranty: For manufacturer's special warranty.

1.5 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit bentonite waterproofing to be installed according to manufacturer's written instructions and warranty requirements.

1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.
2. Do not place bentonite clay products in panel or composite form on damp surfaces unless such practice is approved in writing by manufacturer.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agree(s) to repair or replace components of bentonite waterproofing system that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPOSITE POLYETHYLENE/BENTONITE MEMBRANE

- A. Composite Polyethylene/Bentonite Membrane with Protective Facing: Minimum 170-mil- thick membrane consisting of polyethylene geomembrane bonded to a layer of bentonite and with a protective, nonwoven-geotextile facing.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CETCO, a subsidiary of AMCOL International Corp; Volclay Ultraseal SP.
 - b. Tremco Commercial Sealants & Waterproofing, an RPM company; Paraseal LG or Paraseal W/GM/LG.
 2. Puncture Resistance: 130 lbf according to ASTM D 4833 or 169 lbf according to ASTM E 154.
 3. Vapor Permeance: 0.03 perms according to ASTM E 96/E 96M.

2.2 PROTECTION COURSE

- A. Protection Course: Protection mat of type and thickness as recommended in writing by waterproofing manufacturer for each Project condition.
 1. Adhesive: As recommended in writing by waterproofing manufacturer.

2.3 ACCESSORIES

- A. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 sieve.

- B. Bentonite Mastic: Bentonite compound of trowelable consistency, specifically formulated for application at joints and penetrations.
- C. Bentonite Tubes: Manufacturer's standard 2-inch- diameter, water-soluble tube containing approximately 1.5 lb/ft. of granular bentonite; hermetically sealed; designed specifically for placing on wall footings at line of joint with exterior base of wall.
- D. Termination Bar: Extruded-aluminum or formed-stainless-steel bars with upper flange to receive sealant.
- E. Plastic Protection Sheet: Polyethylene sheeting according to ASTM D 4397; thickness as recommended in writing by waterproofing manufacturer to suit application but at least 6 mils (0.15 mm) thick.
- F. Cement Grout Patching Material: Grout mix compatible with substrate being patched and recommended in writing by waterproofing manufacturer.
- G. Masonry Fasteners: Case-hardened nails or hardened-steel, powder-actuated fasteners. Depending on manufacturer's written requirements, provide 1/2- or 1-inch- diameter washers under fastener heads.
- H. Sealants: As recommended in writing by waterproofing manufacturer. Comply with requirements specified in Section 079200 "Joint Sealants."
- I. Tapes: Waterproofing manufacturer's recommended waterproof tape for joints between sheets, membranes, or panels.
- J. Adhesive: Waterproofing manufacturer's water-based adhesive used to secure waterproofing to both vertical and horizontal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations and other conditions affecting performance of bentonite waterproofing.
- B. Examine bentonite materials before installation. Reject materials that have been prematurely exposed to moisture.
- C. Verify that substrate is complete and that work that will penetrate waterproofing is complete and rigidly installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions.
- B. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.
- C. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than 1/8 inch, honeycomb areas, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.
- D. Excavation Support and Protection System: If water is seeping, use plastic protection sheets or other suitable means to prevent wetting the bentonite waterproofing. Fill minor gaps and spaces 1/8 inch wide or wider with wood, metal, concrete, or other appropriate filling material. Cover or fill large voids and crevices with cement mortar according to manufacturer's written instructions.

3.3 INSTALLATION, GENERAL

- A. Prepare substrates, voids, cracks, and cavities; and install waterproofing and accessories according to manufacturer's written instructions.
 - 1. Before installing, verify the correct side of waterproofing that shall face substrate surface.
 - 2. Apply granular bentonite around penetrations in horizontal surfaces and changes in plane according to manufacturer's details in preparation for bentonite tubes and mastic.
 - 3. Apply bentonite tubes, bentonite mastic, or both at changes of plane, construction joints in substrate, projections, and penetrations.
 - 4. Prime concrete substrates. Primer may be omitted on concrete surfaces that comply with manufacturer's written requirements for dryness, surface texture, and freedom from imperfections.
- B. Apply bentonite tubes continuously on footing against base of wall to be waterproofed.
- C. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts.
- D. Install protection course before backfilling or placing overburden when recommended in writing by waterproofing manufacturer.
 - 1. Inspect and repair waterproofing after reinforcing steel has been placed. Coordinate and control concrete placement to avoid damage to waterproofing.

3.4 COMPOSITE POLYETHYLENE/BENTONITE MEMBRANE INSTALLATION

- A. Install a continuous layer of waterproofing membrane, with ends and edges lapped a minimum of 4 inches unless otherwise indicated. Stagger end joints between membranes a minimum of 24 inches. Seal joints with permanent seam tape.
- B. Below Structural Slabs-on-Grade: Apply waterproofing membrane with polyethylene side down, and staple ends and edges.
 - 1. Install under footings, grade beams, and pile caps; or continue waterproofing through key joints between footings and foundation walls, and extend a minimum of 8 inches up or beyond perimeter slab forms.
 - 2. Protect waterproofing from damage caused by reinforcing bar supports with sharp edges.
- C. Slabs: Starting at lowest point, install a continuous layer of waterproofing membrane, with ends and edges lapped a minimum of 4 inches.
- D. Concrete Walls: Apply mastic to form continuous 3/4-inch cant or fillet at intersection of footings and walls.
 - 1. Starting at lowest point, install a layer of waterproofing membrane horizontally, extending a minimum of 6 inches onto the footing. Lap membrane ends and edges a minimum of 2 inches.
 - 2. Secure membrane to wall.
 - 3. Apply mastic to form continuous 3/4-inch layer around penetrations.
 - 4. Termination at Grade: Extend waterproofing membrane to underside of adjacent slab on grade unless otherwise indicated. Secure top edge with termination bar. Apply sealant to top edge of termination bar.
- E. Excavation Support and Protection (Permanent Shoring): Cut, clean, and treat tiebacks and similar projections. Encase tieback heads, rods, nuts, and plates according to waterproofing manufacturer's written instructions for each configuration. If water is present, cover shoring and lagging with plastic protection sheets; remove plastic sheets before placing concrete.
 - 1. Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped minimum of 4 inches and nailed to shoring.
 - 2. Inspect and repair waterproofing membrane after reinforcing steel has been placed. Coordinate and control concrete placement to avoid damage to waterproofing.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect completed waterproofing installation before covering with other construction, and provide written report stating that installation complies with manufacturer's written instructions.
 - 1. Remove and replace applications of bentonite waterproofing where inspection indicates that it does not comply with specified requirements.

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BEAVERTON SCHOOL DISTRICT
BEAVERTON, OREGON

74-21102-00
26 FEBRUARY 2021
100% CD

END OF SECTION 071700

BENTONITE WATERPROOFING

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SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes film-forming water-repellent treatments for the following vertical and horizontal surfaces:
 - 1. Precast concrete.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's printed statement of VOC content.
 - 2. Include manufacturer's standard colors.
 - 3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
- B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches (300 by 300 mm) in size, with specified water-repellent treatment applied to half of each Sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Applicator.
- B. Product Certificates: For each type of water repellent.
- C. Preconstruction Test Reports: For water-repellent-treated substrates.
- D. Field quality-control reports.

- E. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
- C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, for preconstruction testing, and to set quality standards for materials and execution.
 - 1. Locate mockups in locations that enable viewing under same conditions as the completed Work.
 - a. Size: 10 sq. ft. each.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on field mockups.
 - 1. In addition to verifying performance requirements, use mockups to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrates.
 - 2. Propose changes to materials and methods to suit Project.
 - 3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.8 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
 - 1. Concrete surfaces and mortar have cured for not less than 28 days.
 - 2. Building has been closed in for not less than 30 days before treating wall assemblies.

3. Ambient temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C) and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F (4.4 deg C) and below 100 deg F (37.8 deg C).
5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FILM-FORMING WATER REPELLENTS

- A. Silicone-Resin Sealer, Film-Forming Water Repellent: Clear, polymerized, silicone-resin water repellent for dense substrates; in a solvent- or waterborne solution containing not less than 3 and up to 7 percent solids by weight.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Omegaseal 333 manufactured by Diedrich Technologies, Inc. or comparable product by, but not limited to one of the following:
 - a. Dow Corning Corp.
 - b. Prosoco, Inc.
 - c. Evonik Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.

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2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply coating of water repellent on surfaces to be treated using 15 psi- (103 kPa-) pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
1. Precast Concrete: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent

water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.

- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
 - 1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
 - 3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect. .
- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.
 - 1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
 - 2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Extruded polystyrene foam-plastic board.
 - 2. Glass-fiber blanket.
 - 3. Mineral wool insulation.

- B. Related Requirements:

- 1. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
 - 2. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
 - 3. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 - 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
 - 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (173-kPa) minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
 - 1. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.3 MINERAL WOOL SEMI-RIGID BOARD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Fibrex Insulations Inc.
 - 2. Isolatek International.
 - 3. Owens Corning.

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4. Roxul Inc.
 5. Thermafiber.
- B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Nominal density of 8 lb/cu. ft., Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.3 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
 2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.
- C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
- D. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of dimension indicated between face of insulation and substrate to which anchor is attached.
- E. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.4 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.

2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
 1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
 1. If not otherwise indicated, extend insulation a minimum of 24 inches in from exterior walls.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.

- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
 2. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
 5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE 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. Closed-cell spray polyurethane foam.
- B. Related Requirements:
 - 1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

- A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 2.1 lb/cu. ft. and minimum aged R-value at 1-inch (25.4-mm) thickness of 7.4 deg F x h x sq. ft./Btu at 75 deg F
1. Basis-of-Design Product: Subject to compliance with requirements, provide Heatlok Soy 200+ or comparable product by, but not limited to one of the following:
 - a. Icynene, Inc.
 - b. Dow Corning Corp.
 - c. Certainteed Corp.
 2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.
- B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Spray insulation to envelop entire area to be insulated and fill voids.

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- C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.
- D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.
- E. Cavity Walls: Install into cavities to thickness and/or R value indicated on Drawings.
- F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general 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. Reinforced-polyethylene vapor retarders.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
 - 2. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for vapor retarders in roofing assembly.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 REINFORCED-POLYETHYLENE VAPOR RETARDERS

- A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 29 lb/1000 sq. ft. (13 kg/100 sq. m), with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:

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- a. Insulation Solutions, Inc.
- b. Raven Industries Inc.
- c. Reef Industries, Inc.

2. Material:

- a. Classification: ASTM E1745 Class C
- b. Puncture Resistance: Greater than 1500 grams per ASTM D1709
- c. Tensile strength:
 - 1) New Material: 32 lbs per inch (56 N/cm) per ASTM E154
 - 2) After soaking: 25 lbs per inch (44 N/cm) per ASTM E154

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600

SECTION 072727 - VAPOR PERMEABLE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes self-adhering, water resistive vapor permeable air barriers.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

- B. Shop Drawings: For air-barrier assemblies.
 - 1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
 - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
 - 3. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.
- C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- D. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
- B. Mockups: Build mockups to set quality standards for materials and execution.
 - 1. Build integrated mockups of exterior wall assembly minimum 6 by 6 foot, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
 - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
 - b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
 - c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
 1. Protect substrates from environmental conditions that affect air-barrier performance.
 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.3 SELF-ADHERING SHEET AIR BARRIER

- A. Water resistive vapor permeable air barrier for rainscreen systems: Zero VOC self-adhered vapor permeable air barrier sheet membrane consisting of multiple layers of UV stabilized membrane.

1. Basis of design: Subject to compliance with requirements, provide Wrapshield SA manufactured by Vaproshield LLC or comparable products by, but not limited to the following:
 - a. Grace, W. R. & Co., Perm-A-Barrier VPS
 - b. Meadows, W. R., Inc.
2. Physical and Performance Properties:
 - a. Air Leakage: Maximum 0.00003 cfm/sq. ft. @ 1.57 psf when tested in accordance with ASTM E 2178
 - b. Water Vapor Permeance tested to ASTM E 96 Method B: minimum 40 perms
 - c. Water Resistance tested to AATCC 127, 550 mm hydrostatic head for 5 hours: No leakage
 - d. Tensile Strength tested to ASTM D 882: 44.8 lbf/inch (78 N/mm), machine direction; 25 lbf/inch (43.8 N/mm), cross-machine direction
 - e. Application Temperature: Ambient temperature must be above 20 degrees F
 - f. Surface Burning Characteristics tested to ASTM E 84: Class A
 - g. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Vinyl extrusion with pre-formed fastener and moisture drainage channels configured to create a ventilated airspace between wall cladding and weather-resistive air barrier.
- C. Penetration sealant: Provide sealant for penetrations as recommended by manufacturer and as specified under Division 07 Section: Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

VAPOR PERMEABLE AIR BARRIERS

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2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
 3. Verify that substrates are visibly dry and free of moisture.
 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D 6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.
 1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).

2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
- B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.
- C. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.
 1. Apply sheets in a shingled manner to shed water.
 2. Roll sheets firmly to enhance adhesion to substrate.
- D. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.
- E. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, transition strip.
- F. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- G. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.
 1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
- H. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- I. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.
- J. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- K. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.
 1. Transition Strip: Roll firmly to enhance adhesion.

- L. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- M. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.
- N. Do not cover air barrier until it has been tested and inspected by testing agency.
- O. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
 - 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
 - 2. Continuous structural support of air-barrier system has been provided.
 - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
 - 4. Site conditions for application temperature and dryness of substrates have been maintained.
 - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
 - 6. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
 - 7. Air barrier has been firmly adhered to substrate.
 - 8. Compatible materials have been used.
 - 9. Transitions at changes in direction and structural support at gaps have been provided.
 - 10. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
 - 11. All penetrations have been sealed.
- D. Tests: As determined by testing agency from among the following tests:
 - 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers or ASTM E 1186, chamber depressurization using detection liquids.

2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
 3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
- E. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
 2. Remove and replace deficient air-barrier components for retesting as specified above.
- F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- G. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

- A. Protect wall areas covered with self-adhered water-resistive vapor permeable air barrier from damage due to construction activities, high wind conditions, and extended exposure to inclement weather.
- B. Review condition of self-adhered water-resistive vapor permeable air barrier prior to installation of cladding. Repair, or remove and replace damaged sections with new membrane.
- C. Recommend to cap and protect exposed back-up walls against wet weather conditions during and after application of membrane, including wall openings and construction activity above completed self-adhered water-resistive vapor permeable air barrier installations.
- D. Remove and replace water-resistive weather barrier membrane affected by chemical spills or surfactants.
- E. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 072727

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes fiber-cement siding.
- B. Related Requirements:
 - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, grounds, nailers, and blocking.
 - 2. Section 072100 Thermal Insulation for building insulation.
 - 3. Section 072727 "Vapor Permeable Air Barriers" for weather resistive barriers.

1.3 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Verification: For each type, color, texture, and pattern required.
 - 1. 12-inch- (300-mm-) long-by-actual-width Sample of siding.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding.

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- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain texture and pattern of siding including related accessories, from single source from single manufacturer.
- B. Installer Qualifications: A firm that is approved or licensed by manufacturer for installation of cement board required for this Project and is eligible to receive special warranties specified.
 - 1. In continuous business under same name for past five (5) years.
 - 2. Completed at least three (3) successful installations of specified materials and systems on projects of similar scope.
 - 3. Contractor shall provide all personnel trained in application of materials and systems and shall maintain supervision as specified elsewhere.
- C. Installer Field Supervision: Require installer to maintain a full-time supervisor / foreman on the job site during times that siding systems installation is in progress, and who is experienced in installation of the specified systems.
- D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for siding including accessories.
 - a. Size: 48-inches long by 60-inches high, or as practical and authorized by Owner and/or Architect.
 - b. Include outside corner on one end of mockup and inside corner on other end.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner's Representative specifically approves such deviations in writing.
Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking and deforming.
 - b. Deterioration of materials beyond normal weathering.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.
- B. Basis-of-Design Products: Subject to compliance with requirements, provide SwissPearl Linearis as distributed by authorized SwissPearl distributor or approved equal.
- C. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- D. Nominal Thickness: Not less than 5/16 inch (8 mm).
- E. Panel strips Size: (2500 x 147mm-) with smooth texture.
- F. Large panel size: 1220mm x 2500mm with smooth texture cut to fit as shown on drawings.
- G. Finish: Carat HR

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2.3 ACCESSORIES

- A. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:
- B. Flashing: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim".
- C. Fasteners:
 - 1. For fastening fiber cement, use stainless-steel fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply. System is open joint with panels attached by face fastened screws.
 - 1. Do not install damaged components.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.
- C. Comply with requirements as specified in the Section of these specifications that outlines weather barrier. Required behind siding system.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

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- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

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SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Adhered thermoplastic polyolefin (TPO) roofing system.
 - 2. Vapor retarder.
 - 3. Roof insulation.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
 - 3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

- A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

- A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
 - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
 - 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
1. Base flashings and membrane terminations.
 2. Tapered insulation, including slopes.
 3. Roof plan showing orientation of steel roof deck and orientation of roofing.
 4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- D. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Walkway pads or rolls, of color required.
3. 4-by-4-inch square of overlay board.
4. 12-inch length of metal termination bars

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
 1. Submit evidence of compliance with performance requirements.
- C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is UL listed, FM Global approved for roofing system identical to that used for this Project.
- B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
 1. In continuous business under same name for past 5 years.
 2. Completed at least 3 successful installations of specified materials and systems on projects of similar scope.
 3. Contractor shall provide all personnel trained in application of materials and systems and shall maintain supervision as specified elsewhere.
 4. Installer Field Supervision: Require Installer to maintain a full-time supervisor / foreman on the job site during times that single ply roofing systems installation is in progress, and who is experienced in installation of the specified roofing systems.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
 - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- B. Provide tarps or plastic sheeting required to protect opened roofs and flashings and to prevent the entrance of moisture or rain water into the existing structure until new materials have been applied and roof is in a watertight condition.
- C. Have necessary waterproof canvas or plastic sheeting readily available in case of emergency.
- D. Roofing materials shall not be applied when water in any form (i.e., rain, dew, ice, frost, snow, etc.) is present on the deck.
- E. Provide necessary protection over newly installed membrane during the course of construction at all roof access points and at high traffic areas.
- F. Measures to protect the newly installed membrane shall be employed during the entire duration of the work from staining and damage.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories and other components of roofing system.
 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Must match existing Carlisle FleeceBACK TPO membrane on building. Contractor to field verify.
- B. Source Limitations: Obtain components including roof insulation, fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
 1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
 2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 1. Fire/Windstorm Classification: Class 1A-90.
 2. Hail-Resistance Rating: MH.

- D. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.
- E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.
- F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

- A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible fleece-backed TPO sheet.
 - 1. Thickness: 60 mils, nominal.
 - 2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.
 - 1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
 - 2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:
 - a. Plastic Foam Adhesives: 50 g/L.
 - b. Gypsum Board and Panel Adhesives: 50 g/L.
 - c. Multipurpose Construction Adhesives: 70 g/L.
 - d. Fiberglass Adhesives: 80 g/L.
 - e. Single-Ply Roof Membrane Adhesives: 250 g/L.
 - f. Single-Ply Roof Membrane Sealants: 450 g/L.
 - g. Nonmembrane Roof Sealants: 300 g/L.
 - h. Sealant Primers for Nonporous Substrates: 250 g/L.
 - i. Sealant Primers for Porous Substrates: 775 g/L.
 - j. Other Adhesives and Sealants: 250 g/L.
 - 3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the

Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources
Using Environmental Chambers."

- B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.
- C. Bonding Adhesive: Manufacturer's standard.
- D. Slip Sheet: Manufacturer's standard, of thickness required for application.
- E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.
- F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.
- H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

- A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide DensDeck manufactured by Georgia Pacific, or comparable product by but not limited to one of the following:
 - a. USG.
 - b. Certainteed.
 - c. National Gypsum.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 VAPOR RETARDER

- A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.
- B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type II, 1.5-lb/cu. ft. minimum density, square edged.
- C. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
- D. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope as indicated in drawings unless otherwise indicated.
- E. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
 - 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
 - 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
 - 3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch factory primed.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide DensDeck manufactured by Georgia Pacific, or comparable product by but not limited to one of the following:
 - a. USG.
 - b. Certainteed.
 - c. National Gypsum.

2.9 ASPHALT MATERIALS

- A. Roofing Asphalt: ASTM D 312, Type III or Type IV.
- B. Asphalt Primer: ASTM D 41/D 41M.

2.10 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
 - 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
 - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

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- C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weather tightness of transition and to not void warranty for existing roofing system.

3.4 SUBSTRATE BOARD INSTALLATION

- A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
 - 1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
 - 2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR-RETARDER INSTALLATION

- A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (90 mm) and 6 inches (150 mm), respectively. Seal laps by rolling.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - 1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- G. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
 - 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
 - 2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature
- H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
 - 1. Adhere cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
- I. Install slip sheet over cover board and immediately beneath roofing.

3.7 ADHERED ROOFING INSTALLATION

- A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.
- E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing with side laps shingled with slope of roof deck where possible.
- G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
 3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.
- H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.
- C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manufactured through-wall flashing with counterflashing.
 - 2. Formed roof-drainage sheet metal fabrications.
 - 3. Formed low-slope roof sheet metal fabrications.
 - 4. Formed wall sheet metal fabrications.
 - 5. Formed equipment support flashing.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
 - 3. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.

3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Sustainable Design Submittals:

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: As indicated on Drawings.

2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless-Steel Sheet: ASTM A 240/A 240M, dead soft, fully annealed; with smooth, flat surface.
 - 1. Finish: 2D (dull, cold rolled).
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A 755/A 755M.
 - 1. Surface: Smooth, flat.
 - 2. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F (111 deg C); and complying with physical requirements of ASTM D 226/D 226M for Type I and Type II felts.
- C. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.
- D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

- a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Zinc-Coated (Galvanized), Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 2. Obtain field measurements for accurate fit before shop fabrication.
 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
 - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
 - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing and Fascia Cap: Fabricate in minimum 96-inch long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch wide, joint cover plates. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Standing seam with 45 degree slope at all faces of coping visible from below.
 - 2. Fabricate from the Following Materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- B. Copings: Fabricate in minimum 96-inch long, but not exceeding 12-foot long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, fasten and seal watertight. Shop fabricate interior and exterior corners.
 - 1. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
 - 2. Fabricate from the Following Materials:
 - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
- C. Base Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

- D. Counterflashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- F. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- G. Roof-Drain Flashing: Fabricate from the following materials:
 - 1. Zinc-Tin Alloy-Coated Stainless Steel: 0.015 inch thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
 5. Torch cutting of sheet metal flashing and trim is not permitted.
 6. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches (600 mm) of corner or intersection.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
 2. Use lapped expansion joints only where indicated on Drawings.

- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
 - 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), 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 (4 deg C).
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches (38 mm); however, reduce pre-tinning where pre-tinned surface would show in completed Work.
 - 1. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Parapet Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 - 1. Loosely lock front edge of scupper with conductor head.

3.5 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.8 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

- B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.9 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Roof hatches.

- B. Related Sections:

- 1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
 - 2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
 - 3. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
 - 4. Section 230548 "Vibration and Seismic Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.
 - 5. Section 233423 "HVAC Power Ventilators" for power roof-mounted ventilators.
 - 6. Section 237413 "Packaged, Outdoor, Central-Station Air-Handling Units" for standard curbs specified with rooftop units.

1.3 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak proof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF HATCH

- A. Roof Hatches: Metal roof-hatch units with lids and insulated curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.
 1. Subject to compliance with requirements, provide Bilco with LadderUp Safety Post.
- B. Type and Size: Single-leaf lid, size as indicated in drawings.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Aluminum sheet.
 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
 2. Finish: Mill.
- E. Construction:
 1. Insulation: Manufacturer's standard.
 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
 4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
 5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
 6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter

curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

- F. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
 - 1. Manufacturer: Bilco Bil-Guard
 - 2. Height: 42 inches above finished roof deck.
 - 3. Posts and Rails: Fiberglass reinforced polymer.
 - 4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
 - 5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
 - 6. Fasteners: Manufacturer's standard, finished to match railing system.
 - 7. Finish: Manufacturer's standard.

2.3 METAL MATERIALS

- A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
 - 1. Mill Finish: As manufactured.
 - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).
- B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

ROOF ACCESSORIES

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
 - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
 - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
 - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
 - 1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
 - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
 - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof-Hatch Installation:
 - 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
 - 2. Attach safety railing system to roof-hatch curb.
 - 3. Attach ladder-assist post according to manufacturer's written instructions.
- D. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers.

- B. Related Requirements:

- 1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. A/DFireProtectionSystemsInc.
 - b. GraceConstructionProducts.
 - c. Hilti, Inc.
 - d. Johns Manville.
 - e. Nelson Firestop Products.
 - f. NUCO Inc.
 - g. Passive Fire Protection Partners.
 - h. RectorSeal Corporation.
 - i. Specified Technologies Inc.
 - j. 3M Fire Protection Products.
 - k. Tremco, Inc.; Tremco Fire Protection Systems Group.
- B. USGCorporation Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.

- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
 - 1. Permanent forming/damming/backing materials.
 - 2. Substrate primers.
 - 3. Collars.
 - 4. Steel sleeves.

2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Contractor's name, address, and phone number.
 3. Designation of applicable testing and inspecting agency.
 4. Date of installation.
 5. Manufacturer's name.
 6. Installer's name.

3.5 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out

and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.6 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."
- D. Firestop Systems with No Penetrating Items : Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, C-BJ, F-A- or W-L- 0001-0999.
- E. Firestop Systems for Metallic Pipes, Conduit, or Tubing Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, F-A-, F-C-, W-J-, or W-L- 1001-1999.
- F. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing : Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, F-A-, F-C- or W-L- 2001-2999.
- G. Firestop Systems for Electrical Cables : Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-C-, or W-L- 3001-3999.
- H. Firestop Systems for Cable Trays: Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, or W-L- 4001-4999.
- I. Firestop Systems for Insulated Pipes : Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, F-C- 5001-5999.
- J. Firestop Systems for Miscellaneous Electrical Penetrants: Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-, or F-A-6001-6999.
- K. Firestop Systems for Miscellaneous Mechanical Penetrations: Comply with the following:
 - 1. Available UL-Classified Systems: C-AJ-7001-7999.
- L. Firestop Systems for Groupings of Penetrations: Comply with the following:

1. Available UL-Classified Systems: C-AJ-, C-BJ-, F-A-, or W-L-8001-8999.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Joints in or between fire-resistance-rated constructions.
 - 2. Joints at exterior curtain-wall/floor intersections.
 - 3. Joints in smoke barriers.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
 - 2. Section 079513.13 "Interior Expansion Joint Cover Assemblies" for fire-resistive architectural joint systems.
 - 3. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for fire-resistive architectural joint systems.
 - 4. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

- a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.
 1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
 1. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.
- E. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
 - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
 - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
 - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
 - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
 - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so

labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Latex joint sealants.
 - 5. Low expanding foam sealant.

1.3 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.
- C. Field-Adhesion-Test Reports: For each sealant application tested.

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- D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide Dow Corning 795 or comparable products from, but not limited to, the following:
 - a. GE Advanced materials
 - b. May National Associates, Inc.
 - c. Tremco, Inc.
 - 2. Location: Exterior non paintable surfaces

2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 100/50, T, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, traffic- and non-traffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses NT, M, A, O and I (Class 2)
 - 1. Manufacturers: Subject to compliance with requirements, provide Vulkem 921 or comparable products from, but not limited to, the following:
 - a. BASF Building Systems
 - b. Bostik, Inc.
 - c. Sika Corporation
 - 2. Location: At paintable surfaces.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

- 1. Location: At joints in ceramic tile walls and floor, around equipment and around plumbing fixtures.

2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
- B. Location: At interior frames/walls.

2.6 LOW EXPANDING FOAM SEALANTS

- A. Low expanding, one-component, polyurethane foam sealant, curing to a semi-rigid, closed cell urethane foam. Apply between top of precast concrete panels and metal framing.
- B. Acceptable products:
 - 1. Hilti CF812 WD (Low Pressure polyurethane)
 - 2. Dow GREAT STUFF

2.7 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type O (open-cell material), Type B (bi-cellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.

- c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes interior expansion joint cover assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches (150 mm) long in size.
- D. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- E. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire-resistance ratings.

INTERIOR EXPANSION JOINT COVER ASSEMBLIES

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1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-ceiling assemblies shall be subjected to hose stream testing.
- C. Expansion Joint Design Criteria:
 - 1. Type of Movement: Seismic.
 - a. Joint Movement: As indicated on Drawings.

2.3 WALL EXPANSION JOINT COVERS

- A. Elastomeric-Seal Wall Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide MM Systems VSS-200 or comparable product by, but not limited to, one of the following:
 - a. Nystrom Building Products
 - b. Construction Specialties, Inc.
 - c. Balco, Inc.

INTERIOR EXPANSION JOINT COVER ASSEMBLIES

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2. Application: Wall to wall.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Seal: Preformed elastomeric membranes or extrusions.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 CEILING EXPANSION JOINT COVERS

- A. Elastomeric-Seal Ceiling Joint Cover: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
 1. Basis of Design Product: Subject to compliance with requirements, provide MM Systems VSG-200, or comparable product by, but not limited to, one of the following:
 - a. Nystrom Building Products
 - b. Construction Specialties, Inc.
 - c. Balco, Inc.
 2. Application: Ceiling to ceiling.
 3. Fire-Resistance Rating: Not less than that of adjacent construction.
 - a. Aluminum: Mill.
 4. Seal: Preformed elastomeric membranes or extrusions.
 - a. Color: As selected by Architect from manufacturer's full range.

2.5 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

- E. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 ALUMINUM FINISHES

- A. Mill finish.

2.7 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
 - 2. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fittings and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079513.13

SECTION 079513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes exterior building expansion joint cover assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
 - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches (150 mm) long in size.
- D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
 - 1. Manufacturer and model number for each expansion joint cover assembly.
 - 2. Expansion joint cover assembly location cross-referenced to Drawings.
 - 3. Nominal, minimum, and maximum joint width.
 - 4. Movement direction.
 - 5. Materials, colors, and finishes.
 - 6. Product options.
 - 7. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E 1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.
- C. Expansion Joint Design Criteria:
 - 1. Type of Movement: Seismic.
 - a. Joint Movement: As indicated on Drawings.

2.3 EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Elastomeric-Seal Joint Cover: Assembly consisting of elastomeric seal anchored to surface-mounted frames fixed to sides of joint gap.
 - 1. Basis of Design Product: Subject to compliance with requirements, provide MM Systems VSS-200 or comparable product by, but not limited to, one of the following:
 - a. Nystrom Building Products
 - b. Construction Specialties, Inc.
 - c. Balco, Inc.

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2. Application: Wall to wall.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Seal: Preformed elastomeric membrane or extrusion.
 - a. Color: As selected by Architect from manufacturer's full range.

2.4 MATERIALS

- A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.
 1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
- C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.5 ALUMINUM FINISHES

- A. Mill finish.

2.6 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

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- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

- E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.16

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
 1. Provide compliance with the test procedure standards listed in TABLE 502.4.3 (OEESC).
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 1. Provide additional protection to prevent damage to factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Provide Curries 747 T metal doors with metal frames designed for Curries 747 T doors.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.70 deg Btu/F x h x sq. ft. when tested according to ASTM C 518.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:

HOLLOW METAL DOORS AND FRAMES

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- a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 2, Seamless.
3. Core: Manufacturer's standard.
 4. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 5. Exposed Finish: Prime Factory.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard.
 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Full profile welded.
 4. Exposed Finish: Prime Factory.

2.5 FRAME ANCHORS

- A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 4. Post installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-(9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-

developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
 - 2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
 - 3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
 - 4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
 - 5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
 - c. Compression Type: Not less than two anchors in each frame.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
8. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 45 or 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 - 4. Provide loose stops and moldings on inside of hollow-metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat.

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.

- f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
- B. Related Requirements:
 - 1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
 - 7. Fire-protection ratings for fire-rated doors.
- C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
 - a. Provide Samples for each species of veneer and solid lumber required.
 - b. Provide Samples for each color, texture, and pattern of plastic laminate required.
 - c. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.
3. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on butt side of door with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Exterior Doors: Five years from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide Eggers 5-Ply SCL or comparable products from, but not limited to, the following:
 1. Algoma Hardwoods, Inc.
 2. Graham Wood Doors; an Assa Abloy Group company.
 3. Ideal Wood Products, Inc.
 4. VT Industries Inc.
 5. Weyerhaeuser Company.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
 1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
- C. Structural-Composite-Lumber-Core Doors:
 1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: White Maple.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Slip match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
8. Exposed Vertical and Top Edges: Same species as faces - edge Type A.
9. Core: Structural composite lumber.
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
11. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
12. STC Rating: As indicated

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Same species as door faces.
 2. Profile: Flush rectangular beads.
 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
 1. Grade: Premium.
 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
 3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware"
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 1. Install fire-rated doors according to NFPA 80.
 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-

rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
 - b. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
 2. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.
- B. Related Requirements:
 - 1. Section 077200 "Roof Accessories" for roof hatches.
 - 2. Section 233330 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acudor Products, Inc.
 - b. Babco-Davis; A Cierra Products Co.
 - c. Elmdor/Stoneman; Div. of Acorn Engineering Co.
 - d. Karp Associates, Inc.
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: 12x12 minimum
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
6. Frame Material: Same material and thickness as door.
7. Latch and Lock: As indicated in schedule.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Acudor Products, Inc.
 - b. Babco-Davis; A Cierra Products Co.
 - c. Elmdor/Stoneman; Div. of Acorn Engineering Co.
 - d. Karp Associates, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall and ceiling.
4. Door Size: 12x12 minimum.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed.
7. Frame Material: Same material, thickness, and finish as door.
8. Latch and Lock: Self-latching door hardware, as indicated in schedule.

B. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Acudor Products, Inc.
 - b. Babco-Davis; A Cierra Products Co.
 - c. Elmdor/Stoneman; Div. of Acorn Engineering Co.
 - d. Karp Associates, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
 3. Locations: Wall and ceiling.
 4. Door Size: 12x12 minimum.
 5. Fire-Resistance Rating: Not less than that of adjacent construction.
 6. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage, factory primed.
 7. Frame Material: Same material, thickness, and finish as door.
 8. Latch and Lock: Self-closing, self-latching door hardware, as indicated in schedule.

2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.
- D. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- E. Frame Anchors: Same material as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Provide Olympus National lock sets 100-200 series

E. Aluminum: After fabrication, apply manufacturer's standard protective coating on aluminum that will come in contact with concrete.

2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

ACCESS DOORS AND FRAMES

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3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior storefront framing.
 - 2. Exterior manual-swing entrance doors and door-frame units.
 - 3. Sunshades.
 - 4. Light Shelves.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.

- b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- C. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 8.00 lbf/sq. ft. (300 Pa).

H. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

I. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.2 MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Kawneer VG 451T for storefront and Kawneer insulclad 360 for entrance doors or comparable product by, but not limited to, one of the following:
1. EFCO.
 2. TRACO.
 3. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: As indicated.
 4. Finish: High-performance organic finish.
 5. Fabrication Method: Field-fabricated stick system.

- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
 - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
 - 1. Door Construction: 2- to 2-1/4-inch (50.8- to 57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, thermally broken extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Medium stile; 4-1/16 inch nominal width.
 - 3. Glazing Stops and Gaskets: snap-on, extruded-aluminum stops and preformed gaskets.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
 - 1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products complying with BHMA standard referenced.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
 2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.
- D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 2. Exterior Hinges: Nonferrous.
 3. Quantities:
 - a. For doors up to 87 inches (2210 mm) high, provide three hinges per leaf.
 - b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm) high, provide four hinges per leaf.
- E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- F. Cylinders: BHMA A156.5, Grade 1.
 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE".
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Removable Mullions: BHMA A156.3, extruded aluminum.
 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic

protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

- J. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- K. Concealed Overhead Holders: BHMA A156.8, Grade 1.
- L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- M. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- N. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- O. Silencers: BHMA A156.16, Grade 1.
- P. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).
- Q. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
 - 2. At exterior doors, provide weather sweeps applied to door bottoms.
- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

- A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.10 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 1. Water Penetration Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 503 and shall not evidence water penetration, defined as any water appearing on the interior surfaces of framing or glass other than condensation.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Should the tested units not pass the test, the Contractor is required to:
- E. 1. Correct the failed unit.
- F. 2. Re-test the failed unit at Contractor's expense until the unit passes the test.
- G. 3. Successfully test an additional unit at Contractor's expense.
- H. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Folding doors.
- 2. Cylinders for door hardware specified in other Sections.
- 3. Electrified door hardware.

- B. Related Requirements:

- 1. Section 123216 "Manufactured Plastic-Laminate-Faced Casework" for cabinet door hardware provided with cabinets.
- 2. Section 081113 "Hollow Metal Doors and Frames".
- 3. Section 081416 "Flush Wood Doors".
- 4. Section 083113 "Access Doors and Frames" for access door hardware, including cylinders.
- 5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.
- 6. Section 084113 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, including cylinders.
- 7. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.
- 8. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.
- 9. Section 281600 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 - 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

- a. Electromagnetic Locks: Five years from date of Substantial Completion.
- b. Exit Devices: Two years from date of Substantial Completion.
- c. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled on Drawings and in Section 087100.01.

2.4 PARTS LIST

- A. See Section 087100.01
 - 1. Substitutions must be submitted in advance.

2.5 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
 - 1. Coordinate keying and cylinder keyway with owner's requirements.

2.6 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:

- 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.7 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until blocking reinforcement and finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. Engage Installer to train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

- A. As indicated on drawings.

Hardware Group No. 1

For use on Door #(s):

G100

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------------|--|--------|-----|
| 8 | EA | HINGE | 5BB1HW 5 X 5 NRP | 630 | IVE |
| 1 | EA | POWER TRANSFER | EPT10 CON | ✓ 689 | VON |
| 1 | EA | REMOVABLE MULLION | KR4954 STAB | 689 | VON |
| 1 | EA | PANIC HARDWARE | LD-XP99-EO | 626 | VON |
| 1 | EA | ELEC PANIC HARDWARE | RX-QEL-XP99-NL-CON 24 VDC | ✓ 626 | VON |
| 1 | EA | RIM CYLINDER | 20-057 ICX | 626 | SCH |
| 2 | EA | MORTISE CYLINDER | 20-061 ICX 36-083 | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 EDA TBWMS | 689 | LCN |
| | | | PROVIDE BSD DISTRICT STD MOUNTING PLATE | | |
| 1 | EA | SURF. AUTO OPERATOR | 4642 WMS | ✓ 689 | LCN |
| 1 | EA | MOUNTING PLATE | 4110-18 | 689 | LCN |
| | | | OMIT IF TOP RAIL IS TALL ENOUGH TO MOUNT CLOSER | | |
| 1 | EA | WEATHER RING | 8310-801 | PLA | LCN |
| 1 | EA | ACTUATOR, JAMB MOUNT | 8310-818T | ✓ 630 | LCN |
| 1 | EA | SURFACE MOUNT BOX | 8310-819S | ✓ PLA | LCN |
| 1 | EA | ACTUATOR, WALL MOUNT | 8310-853T | ✓ 630 | LCN |
| 1 | EA | FLUSH MOUNT BOX | 8310-867F | ✓ 689 | LCN |
| 2 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| | | | INSTALL ON BOLLARDS | | |
| 1 | EA | RAIN DRIP | 346C | AL | PEM |
| 1 | EA | MULLION SEAL | 5110BL | BLK | PEM |
| 1 | EA | WIRE HARNESS | CON-26P | ✓ | SCH |
| | | | POWER TRANSFER TO ELECTRIFIED HARDWARE | | |
| 1 | EA | WIRE HARNESS | CON-6W | ✓ | SCH |
| | | | FROM INCOMING POWER SUPPLY | | |
| 2 | EA | DOOR CONTACT | 679-05HM | ✓ BLK | SCE |
| 1 | EA | POWER SUPPLY | PS902 900-2RS 900-BBK 120/240 VAC | ✓ | VON |
| | | | ACCESS CONTROL - WORK OF DIVISION 28 | | |
| | | | BOLLARD(S) PROVIDED BY CONTRACTOR | | |
| | | | PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS | | |
| | | | PROVIDE RISER DIAGRAMS | | |
| | | | WEATHERSTRIP, THRESHOLD, AND SWEEP(S) BY DOOR MANUFACTURER | | |

120VAC TO POWER SUPPLY AND ADA OPERATOR. HOME RUN FROM POWER SUPPLY TO QEL DEVICE AS FOLLOWS: 200FT/18 AWG, 320FT/16 AWG, 500FT/14 AWG, OR 800FT/12 AWG. COORDINATE CARD READER AND ACTUATOR MOUNTING LOCATIONS ON WALLS AND BOLLARDS PRIOR TO MOUNTING. DOOR CONTACT LISTED IS A PLACE HOLDER FOR PREP ONLY. DOUBLE POLE DOUBLE THROW DOOR CONTACT TO BE SUPPLIED BY DIVISION 28. WEATHER HOOD FOR CARD READER AND OR ACTUATOR TO ALSO BE SUPPLIED BY DIVISION 28.

Hardware Group No. 2

For use on Door #(s):

G101 G103

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|-----|------------------------------------|------------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | PRIVACY WITH OCCUPIED INDICATOR | L9456T 06A L583-363 L283-722 | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4011 WMS | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP/HOLDER | WS40 | 626 | IVE |
| | | | INSTALL AT TOP OF DOOR | | |
| 1 | SET | SEALS | S88D | DKB | PEM |

MOUNT WS40 NEAR LEADING EDGE PULL SIDE OF DOOR LIKE A MAG HOLDER ARMATURE WOULD MOUNT.

Hardware Group No. 3

For use on Door #(s):

G102 G104 G106 G108 G114.1 G114

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|---------------------|-----------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | VANDL ENTRANCE LOCK | ND92TD RHO K510-066 | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CCV | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

Hardware Group No. 4

For use on Door #(s):
G112

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|---------------------|-----------------------------|--------|-----|
| 3 | EA | HINGE | 5BB1HW 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | VANDL ENTRANCE LOCK | ND92TD RHO K510-066 | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CCV | 630 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

Hardware Group No. 5

For use on Door #(s):
G110

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|---------------------|--|--------|-----|
| 6 | EA | HINGE | 5BB1HW 4.5 X 4.5 NRP | 652 | IVE |
| 1 | EA | REMOVABLE MULLION | KR4954 STAB | 689 | VON |
| 1 | EA | PANIC HARDWARE | LD-99-EO | 626 | VON |
| 1 | EA | PANIC HARDWARE | LD-99-L-2SI-06 | 626 | VON |
| 1 | EA | MULLION STORAGE KIT | MT54 | 689 | VON |
| | | | REINFORCEMENT REQUIRED. PROVIDE BSD DISTRICT STD SPACER. | | |
| 1 | EA | RIM CYLINDER | 20-057 ICX | 626 | SCH |
| 1 | EA | MORTISE CYLINDER | 20-061 ICX 36-083 | 626 | SCH |
| 1 | EA | RIM CYL THUMBTURN | XB11-979 | 626 | SCH |
| 2 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 2 | EA | SURFACE CLOSER | 4111 EDA TBWMS | 689 | LCN |
| 2 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 2 | EA | WALL STOP/HOLDER | WS40 | 626 | IVE |
| | | | INSTALL AT TOP OF DOOR | | |
| 1 | EA | MULLION SEAL | 5110BL | BLK | PEM |
| 2 | EA | SILENCER | SR64 | GRY | IVE |

Hardware Group No. 6

For use on Door #(s):
G110.2

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|------------------|-----------------------------|--------|-----|
| 4 | EA | HINGE | 5BB1HW 5 X 4.5 NRP | 630 | IVE |
| 1 | EA | PANIC HARDWARE | XP99-NL | 626 | VON |
| 1 | EA | RIM CYLINDER | 20-057 ICX | 626 | SCH |
| 1 | EA | MORTISE CYLINDER | 20-061 ICX | 626 | SCH |
| 2 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |
| 1 | EA | SURFACE CLOSER | 4111 EDA WMS | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS TKTX | 630 | IVE |
| 1 | EA | WALL STOP | WS406/407CVX | 630 | IVE |
| | | | INSTALL ON BOLLARD | | |
| 1 | EA | RAIN DRIP | 346C | AL | PEM |
| 1 | EA | DOOR SWEEP | 315CN | AL | PEM |
| 1 | EA | THRESHOLD | 172A MSES10 | AL | PEM |
| 1 | EA | DOOR CONTACT | 679-05HM | ✓ BLK | SCE |
| | | | BOLLARD PROVIDED BY | | |
| | | | CONTRACTOR | | |
| 1 | | | WEATHERSTRIP BY | | |
| | | | DOOR/FRAME MANUFACTURER | | |

Hardware Group No. 7

For use on Door #(s):
G114.2

Provide each BP door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|--|-------------|------------------|--------|-----|
| | | | HARDWARE BY DOOR | | |
| | | | MANUFACTURER | | |

Hardware Group No. 8

For use on Door #(s):
OG1 OG2

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|-----|----|----------------|----------------|--------|-----|
| 6 | EA | HINGE | 2062.100 | 600 | GGH |
| 1 | EA | PANIC HARDWARE | LD-99-EO-WH | 626 | VON |
| 1 | EA | PANIC HARDWARE | LD-99-NL-WH | 626 | VON |
| 1 | EA | RIM CYLINDER | 20-057 ICX | 626 | SCH |
| 1 | EA | FSIC CORE | 23-030 EV29 T | 626 | SCH |

GATE CLOSERS BY GATE MANUFACTURER

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for windows, doors, storefront framing, glazed curtain walls, skylights.
 - 2. Glazing sealants and accessories.

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For glass.
- C. Product Test Reports: For tinted glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Sunguard by Guardian or comparable products by, but not limited to, one of the following:

1. AGC Glass Company North America, Inc.
 2. Pilkington North America, Inc.
 3. Saint-Gobain Corporation
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
1. Obtain tinted glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. Design Snow Loads: As indicated on Drawings.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
 - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Ultraclear Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3; and with visible light transmission of not less than 91 percent.
- C. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- D. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

- E. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with primary and secondary sealants.
 - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

- a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type CG: Ultra-clear low Iron float glass, heat strengthened.
 - 1. Minimum Thickness: 6 mm.
- B. Glass Type CTG: Uncoated Ultra-clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
- C. Glass Type TRTG: Translucent fully tempered float glass: Uncoated clear, acid etched on 2nd surface.
 - 1. Minimum Thickness: 6 mm.

3.9 INSULATING GLASS SCHEDULE

- A. Glass Type ICG: Low-E-coated, clear insulating glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Minimum Thickness of Each Glass Lite: 6 mm.
 - 3. Outdoor Lite: float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: float glass.
 - 6. Low-E Coating: Pyrolytic on second surface.

7. Winter Nighttime U-Factor: 0.29 maximum.
8. Summer Daytime U-Factor: 0.27 maximum.
9. Visible Light Transmittance: 60 percent minimum.
10. Solar Heat Gain Coefficient: 0.27 maximum.

B. Glass Type ICTG: Low-E-coated, clear tempered insulating glass.

1. Basis of Design: SIGMA 64-7-2
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Fully tempered float glass.
5. Interspace Content: Air.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Pyrolytic on second surface.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.27 maximum.
10. Visible Light Transmittance: 60 percent minimum.
11. Solar Heat Gain Coefficient: 0.27 maximum.

C. Glass Type IG: Low-E-coated, clear insulating glass.

1. Basis of Design Product: Sunguard SN 68
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: float glass.
5. Interspace Content: Air.
6. Indoor Lite: float glass.
7. Low-E Coating: Pyrolytic on second surface.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.28 maximum.
10. Visible Light Transmittance: 68 percent minimum.
11. Solar Heat Gain Coefficient: 0.38 maximum.

D. Glass Type TIG: Low-E coated, tinted insulating glass.

1. Basis-of-Design Product: Sunguard 'CrystalGray' tinted glass with SN68 on #2.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted heat-strengthened float glass.
5. Tint Color: Crystal Gray.
6. Interspace Content: Air.
7. Indoor Lite: Clear float glass.
8. Low-E Coating: Pyrolytic on second surface.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Summer Daytime U-Factor: 0.28 maximum.
11. Visible Light Transmittance: 34 percent minimum.
12. Solar Heat Gain Coefficient: 0.28 maximum.

- E. Decorative Glass Type SG-1/2/3: Laminated glass with decorative interlayer.
1. Basis-of-Design Product: 3Form.
 2. Construction: Two plies of clear fully tempered float glass.
 3. Thickness of Each Glass Ply: 3 mm.
 4. Construction: Laminate glass with PVB interlayer or cast-in-place and cured, transparent, resin interlayer to comply with interlayer manufacturer's written instructions.
 5. Interlayer Color and Pattern: As selected by Architect from manufacturer's full range.

END OF SECTION 088000

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.
2. Fixed, formed-metal acoustical louvers.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.

1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Windborne-debris-impact-resistance test reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

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2. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft. (1436 Pa) acting inward or outward.
 3. Wind Loads: Determine loads based on pressures indicated below:
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Design earthquake spectral response acceleration, short period (Sds) for Project if dictated in structural design
- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.
- F. Windborne-Debris-Impact Resistance: Louvers located within 30 feet (9.1 m) of grade shall pass enhanced-protection, large-missile testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than louvers indicated for use on Project.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Non-Drainable-Blade Louver:
1. Basis of Design Product: Subject to compliance with performance requirements, provide products by one the following:
 - a. Air Balance Inc.; a Mestek company.
 - b. Air Flow Company, Inc.
 - c. Airolite Company, LLC (The).
 - d. All-Lite Architectural Products.
 - e. American Warming and Ventilating
 - f. Arrow United Industries; a division of Mestek, Inc.
 - g. Construction Specialties, Inc.
 - h. Dowco Products Group; Safe Air of Illinois.
 - i. Greenheck Fan Corporation.
 - j. Industrial Louvers, Inc.
 - k. Louvers & Dampers; a division of Mestek, Inc.
 - l. NCA Manufacturing, Inc.

- m. Nystrom, Inc.
 - n. Pottorff.
 - o. Reliable Products, Inc.
 - p. Ruskin Company; Tomkins PLC.
 - q. United Enertech.
- 2. Louver Depth: < 5 inches, unless shown or otherwise noted on Drawings.
 - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm) for blades and 0.080 inch (2.03 mm) for frames.
 - 4. Louver Performance Ratings:
 - a. Free Area: Not less than 8.5 sq. ft. (0.79 sq. m for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver, or as called for in Drawings.
 - b. Point of Beginning Water Penetration: Not less than 0.01 oz/sq. ft. at 1250 fms free area velocity.

2.4 BLANK-OFF PANELS

- A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
 - 1. Aluminum sheet for aluminum louvers, not less than 0.050-inch (1.27-mm) nominal thickness.
 - 2. Panel Finish: Same finish type applied to louvers, but black color.
 - 3. Attach blank-off panels with sheet metal screws.

2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.6 FABRICATION

- A. Factory-assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.
 - 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 - 2. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.
- B. Related Sections include the following:
 - 1. Division 5 Section "Cold-Formed Metal Framing" for other exterior and interior load-bearing and non-load-bearing wall stud and furring.
 - 2. Division 7 Section "'Joint Sealants" for acoustical sealant.
 - 3. Division 7 Section "Penetration Firestopping" for fire rated sealant.

1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated Retain "STC Rating" Paragraph below if required to reduce airborne sound transmission.
- B. STC Rating: As indicated
- C. Gypsum Shaftliner Board:
 1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch (25.4 mm) thick, with double beveled long edges.
 - a. American Gypsum; Shaft Liner.
 - b. CertainTeed Corp.; ProRoc Shaftliner.
 - c. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
 - d. Lafarge North America, Inc.; Firecheck Type X Shaftliner.
 - e. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
 - f. PABCO Gypsum; Pabcore Shaftliner Type X.
 - g. Temple-Inland Inc.; Fire-Rated SilentGuard Gypsum Shaftliner System.
 - h. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
 1. Protective Coating: ASTM A 653/A 653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

GYPSUM BOARD SHAFT WALL ASSEMBLIES

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1. Depth: As indicated Minimum Base-Metal Thickness: As indicated
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm long and matching studs in depth.
- G. Minimum Base-Metal Thickness: As indicated Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
 - b. Metal-Lite, Inc.; The System.
- H. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches (76 mm), matching studs in depth, and not less than 0.033 inch (0.84 mm thick.
- I. Finish Panels: As indicated Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch (0.84-mm) minimum thickness of base metal (uncoated).
- F. Gypsum Board Cants:
 - 1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 1/2- or 5/8-inch (13- or 16-mm) panels.
 - 2. Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."
 - 3. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
 - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
 - 2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Gypsum Board Cants: At projections into shaft exceeding 4 inches (102 mm), install gypsum board cants covering tops of projections.
 - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches (610 mm) o.c. with screws fastened to shaft wall framing.
 - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches (610 mm) o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirements
 - 1. Division 06 Section "Miscellaneous Rough Carpentry" for general framing.

1.2 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 10 lbf/sq. ft. (480 Pa)

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645
 - 1. Steel Studs and Tracks.
- C. Minimum Base-Metal Thickness: As required by performance requirements for horizontal deflection Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch (38-mm) minimum vertical movement.
 - 2. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 - 3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - 1. Depth: 1-1/2 inches (38 mm).
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - 1. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm)
 - 2. Depth: 7/8 inch (22.2 mm).
- F. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
 - 1. Configuration: Asymmetrical or hat shaped.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor or adhesive anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 2-1/2 inches (64 mm).

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
 - b. Depth: 1-5/8 inches (41 mm) See "Embossed Steel Studs and Tracks" Article in the Evaluations for information about embossed steel studs and tracks.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
 - 2. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Install two studs at each jamb unless otherwise indicated.
 - 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 4. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 5. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 6. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm o.c.).
 2. Carrying Channels (Main Runners): 48 inches (1219 mm o.c.).
 3. Furring Channels (Furring Members): 16 inches (406 mm).
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support Grid suspension systems are suitable for use with gypsum board. They might be acceptable for gypsum veneer plaster; consult gypsum veneer plaster and grid suspension system manufacturers.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

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END OF SECTION 092216

NON-STRUCTURAL METAL FRAMING

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.
 - 2. Tile backing panels.

- B. Related Requirements:

- 1. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
 - 2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
 - 3. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C 1396/C 1396M.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Gypsum.
 2. CertainTeed Corp.
 3. Georgia-Pacific Gypsum LLC.
 4. Lafarge North America Inc.
 5. National Gypsum Company.
 6. PABCO Gypsum.
 7. Temple-Inland.
 8. USG Corporation.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Thickness: 5/8 inch (15.9 mm).
 2. Long Edges: Tapered.
- D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
 1. Thickness: 1/2 inch (12.7 mm).

2. Long Edges: Tapered.

- E. Abuse-Resistant Gypsum Board: ASTM C 1396/C 1396M gypsum board, tested according to ASTM C 1629/C 1629M.
1. Core: As indicated on Drawings 5/8 inch (15.9 mm), Type X.
 2. Surface Abrasion: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 3. Indentation: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 4. Soft-Body Impact: ASTM C 1629/C 1629M, meets or exceeds Level 2 requirements.
 5. Long Edges: Tapered.
 6. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- F. "Impact-Resistant Gypsum Board" Paragraph below describes products tested according to ASTM C 1629/C 1629M for resistance to abrasion, indentation, and soft- and hard-body impact. See "Abuse- and Impact-Resistant Gypsum Board" Article in the Evaluations for additional information. Verify availability with manufacturers.
- G. Type C gypsum board has fire-resistive capability greater than that of Type X. Design designations of independent testing agencies indicated on Drawings generally determine product requirements for Type C gypsum board. Type C gypsum board from different manufacturers cannot be intermixed because the ratings apply only to assemblies identical in materials and construction to those tested.
- H. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
1. Thickness: 1/2 inch (12.7 mm)
 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- I. Water-Resistant Gypsum Backing Board: ASTM C 1396/C 1396M, with manufacturer's standard edges.
1. Core: As indicated on Drawings

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc
 2. Shapes:
 - a. Cornerbead.
 - b. L-Bead: L-shaped; exposed long flange receives joint compound.
 - c. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.
 - 3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings
 - 2. Type X: As indicated on Drawings
 - 3. Ceiling Type: Ceiling surfaces
 - 4. Abuse-Resistant Type: In Gymnasium
 - 5. Impact-Resistant Type: As indicated on drawings.
 - 6. Mold-Resistant Type: As indicated on Drawings.
 - 7. Glass-Mat Interior Type: As indicated on Drawings.
- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners

3.4 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile
- C. Water-Resistant Backing Board: Install where indicated with 1/4-inch (6.4-mm) gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners
 - 2. L-Bead: Use where indicated or recommended by manufacturer.
 - 3. J-trim: Use at exposed edges of boards and where boards abut caulked joints with dissimilar materials.

3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- D. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 – CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Porcelain tile.
 - 2. Glazed wall tile.
 - 3. Crack isolation membrane.
 - 4. Metal edge strips.

- B. Related Requirements:

- 1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 2. Section 092900 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 1. Full-size units of each type and composition of tile and for each color and finish required.
 2. Full-size units of each type of trim and accessory.
 3. Stone thresholds in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product.
- D. Product Test Reports: For tile-setting and -grouting products.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 - 2. Obtain crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Crack isolation membrane.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced

by TCNA installation methods specified in tile installation schedules, and other requirements specified.

- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

A. Tile Type CT-1: Colorbody porcelain tile.

1. Products: Basis-of-Design products from Daltile, Kestones.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 2 by 2 inches.
4. Face Size Variation: Rectified.
5. Thickness: 1/4 inch.
6. Face: Speckle.
7. Finish: Matte
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Tile Color, Glaze, and Pattern: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
10. Grout Color: As indicated in Color and Materials Schedule in drawings or

B. Tile Type CT-2, CT-2A, CT-2B, CT-3: Glazed wall tile.

1. Products: Basis-of-Design products from Daltile, Semi-Gloss.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 4.25 x 4.25 inches.
4. Face Size Variation: Rectified.
5. Thickness: 5/16 inch
6. Face: Solid with square edges.
7. Dynamic Coefficient of Friction: N/A.
8. Tile Color, Glaze, and Pattern: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Grout Color: As selected by Architect from manufacturer's full range.

C. Tile Base CT-2C: Glazed wall tile.

1. Products: Basis-of-Design products from Daltile, Semi-Gloss.
2. Module Size: 4.25" x 6" cove.
3. Thickness: 5/16 inch.
4. Face: Solid color, with manufacturer's standard edges.
5. Finish: Gloss.
6. Tile Color and Pattern: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
7. Grout Color: As selected by Architect from manufacturer's full range.

2.4 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
- C. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

2.5 SETTING MATERIALS

- A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI A108.1 and as specified below.
 - 1. Latex additive (water emulsion) described below, of type specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.
 - a. Latex Additive: Manufacturer's standard.
- B. Latex-Portland Cement Mortar: ANSI A118.4, composition as follows:
 - 1. Latex additive (water emulsion) of type described below, combined at job site with prepackaged dry mortar mix supplied or specified by latex additive manufacturer.
 - a. Latex Type: Manufacturer's standard.
 - b. Latex-Portland Cement Mortar shall be quality similar to Custom Building Products ProLite Tile and Stone Mortar.

2.6 GROUT MATERIALS

- A. Chemical-Resistant Epoxy Grout: ANSI A118.3. Manufacturer standard colors:
- B. Quality of epoxy grout used on this Project shall be similar to Custom Building Products CEG-Lite.

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, designed specifically for flooring applications; exposed-edge material.
 - 1. Outside Corners (SCHL-1): Schluter Systems anodized aluminum Schiene.
 - a. Schiene to be used at wall tile at flash coved base areas only.
 - 2. Outside Corners (SCHL-2): Schluter Systems anodized aluminum Rondec.
 - a. Rondec to be used at outside corners of wall tile.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

2.9 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with requirements of Division 07 Section "Joint Sealants," including ASTM C 920 as referenced by Type, Grade, Class, and Uses.
- B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.
- C. One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes.
- D. Products: Subject to compliance with requirements, provide one of the following:
 - 1. One-Part Mildew-Resistant Silicone Sealant:
 - a. "Dow Corning 786"; Dow Corning Corp.
 - b. "Sanitary 1700"; GE Silicones.

- c. "898 Sanitary Silicone Sealant"; Pecora Corp.
- d. "Rhodorsil 6B White"; Rhone-Poulenc Inc.
- e. "Tremsil 600 White"; Tremco Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Glazed Wall Tile: 1/8 inch (3.2 mm).
 - 2. Porcelain Floor Tile: 1/8 inch (3.2 mm).
- G. Lay out tile wainscots to dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

- I. Metal Edge Strips: Install at locations indicated.

3.4 CRACK ISOLATION MEMBRANE INSTALLATION

- A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
- B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 1. Remove grout residue from tile as soon as possible.
 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:

1. Floor Tile, Typical: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and grout types:
 - a. Crack Isolation Mat: TCNA F125-Partial Coverage.
 - b. Latex Modified Portland Cement Mortar: ANSI A108.4
 - c. Bond Coat: Latex-portland cement mortar, ANSI A108.4 or ANSI A108.5.
 - 1) Concrete Subfloors, Typical: TCNA F115-13 on medium bed.
 - 2) Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 1. Tile Installation TCNA W244C - 13; thinset mortar on cementitious backer units.
 - a. Thinset Mortar: Latex Portland Cement Mortar: ANSI A108.4.
 - b. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, provide 6 inch (150 mm) sample size.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.
- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

ACOUSTICAL PANEL CEILINGS

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1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Class A according to ASTM E 1264.
 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS (APC-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Fine Fissured, 895 as manufactured by Armstrong World Industries, Inc.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
 - 1. Type and Form: Type XII, mineral-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
 - 2. Pattern: E (lightly textured)] Fine
- D. Color: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
- E. Light Reflectance (LR): 0.81
- F. Noise Reduction Coefficient (NRC): 0.55
- G. Ceiling Attenuation Class (CAC): Not less than 35.
- H. Edge/Joint Detail: Square Lay-in
- I. Thickness: 5/8 inch
- J. Modular Size: 24 by 48 inches
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
 - 1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.
- D. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- F. Seismic Clips: seismic clips designed and spaced to secure acoustical panels in place.
 - 1. Hemmed aluminum-capped angle molding with prefinished exposed flanges, 7/8" width. Basis of Design Seismic clip: BERC2 retaining clip.

2.5 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Prelude XL as manufactured by Armstrong World Industries, Inc:
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
 - 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.
- C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16 inch wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel.
 - 5. Cap Finish: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

2.6 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- H. Three way clips: GC3W Grip clip 3-Way for APC-1

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
 - a. Moldings for seismic constraint; Basis of Design Product: BERC2 retaining clip, part of the Seismic RX system by Armstrong World Industries, Inc.
 - 2. Where indicated on drawings for lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 - a. Armstrong Shadow Molding

3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
 - B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - C. Seismic Restraint Wall Moldings: Hemmed aluminum-capped angle molding with prefinished exposed flanges, 7/8" width. Basis of Design Seismic clip: BERC2 retaining clip.
- 2.8 METAL EDGE MOLDINGS AND TRIM (Perimeter Termination not adjacent to walls)
- A. Basis-of-Design Product: Subject to compliance with requirements, provide Axiom Classic as manufactured by Armstrong World Industries, Inc., or a comparable product by one of the following:
 - B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- 2.9 ACOUSTICAL SEALANT
- A. Acoustical Sealant: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.

3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095423 - LINEAR METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes linear metal suspension systems for both interior and exterior ceilings.
- B. Related Requirements:
 - 1. Section 095113 "Acoustical Panel Ceilings" for clip-in, lay-in, snap-in, and torsion-spring-hinged metal pan ceilings with exposed suspension systems.
 - 2. Section 054000 "Cold-Formed Metal Framing" for framing members.

1.3 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

1.4 COORDINATION

- A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.5 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.

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- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
1. Linear Metal Pan: Set of 12-inch- (300-mm-) long Samples of each type and color and a 12-inch- (300-mm-) long spliced section.
 2. Suspension System Members: 12-inch- (300-mm-) long Sample of each type.
 3. Exposed Molding and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
 4. Filler Strips: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
 5. Sound Absorber: 12 inches (300 mm) long.
 6. End Cap: Full size.
- D. Delegated-Design Submittal: For design of seismic restraints and attachment devices.

1.7 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Linear pattern.
 2. Joint pattern.
 3. Ceiling suspension members.
 4. Method of attaching hangers to building structure.
 - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 6. Ceiling perimeter and penetrations through ceiling; trim and moldings.
 7. Minimum Drawing Scale: 1/8 inch.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each linear metal ceiling, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For linear metal ceiling and components.
- E. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.10 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by National Voluntary Laboratory Accreditation Program for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.12 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install linear metal ceilings until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements" to design seismic restraints and attachment devices.

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- B. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling pans; or permanent damage to fasteners and anchors:
 - 1. Wind Load: Uniform pressure as indicated on Drawings, acting inward or outward.
 - 2. Seismic Criteria: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - a. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580/E 580M.
 - b. CISCAs Recommendations for Acoustical Ceilings: Comply with CISCAs "Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings - Seismic Zones 0-2."
 - c. CISCAs Guidelines for Systems Requiring Seismic Restraint: Comply with CISCAs "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies - Seismic Zones 3 & 4."
 - d. ASCE/SEI 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
- D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 LINEAR METAL CEILING PANS

- A. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B 209 (ASTM B 209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
 2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C 635/C 635M.
 - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A 879/A 879M, 04Z (12G) coating; surface treatment as recommended by finish manufacturer for type of use and finish indicated.
 - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A 1008/A 1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
 3. Stainless-Steel Sheet: Complying with ASTM A 240/A 240M.
 4. Extruded Aluminum complying with ASTM D 958 – Practice for Determining Temperatures of Standard ASTM Molds for Test Specimens of Plastics and ASTM B221.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.
- D. Pan Splices: Construction same as pans, in lengths 8 to 12 inches (200 to 300 mm); with manufacturer's standard finish.
- E. End Caps: Manufacturer's standard material; fabricated to fit and conceal exposed ends of pans.
- F. Filler Strips: Manufacturer's standard material; fabricated to uninterruptedly close voids between pans.
- G. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.
- H. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84.
1. Bond fabric layer to pan in the factory with manufacturer's standard nonflammable adhesive.
- I. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:

1. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of non-rigid, PVC plastic sheet encapsulating un-faced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:
 - a. Mineral-Fiber Type and Thickness: Glass fiber; 1 inch (25 mm).
 - b. Mineral-Fiber Density: 3/4 lb/cu. ft. (12 kg/cu. m).
 - c. Plastic Sheet Thickness and Color: Not less than 0.003 inch (0.076 mm); flat black.
2. Unwrapped, Glass-Fiber Insulation: Black-coated, un-faced, glass-fiber insulation complying with ASTM C 553, Type I, II, or III, not less than 1-lb/cu. ft. (16-kg/cu. m) density, treated to be non-dusting, and as follows:
 - a. Thickness: 1 inch (25 mm).

2.3 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635/C 635M requirements.
- B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung, unless otherwise indicated.
 1. Cast-in-Place and Post-Installed Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Postinstalled expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC service condition (mild).
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchors.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
 2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without

failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

- D. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C 635/C 635M, Table 1, Direct Hung is less than yield stress of wire, but provide not less than 0.135-inch- (3.5-mm-) diameter wire.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed from 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- G. Carriers: Factory finished with matte-black baked finish.
1. Main Carriers: Aluminum, not less than 0.240-inch (6.0-mm) rolled sheet, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, complying with ASTM B 209 (ASTM B 209M).
 2. Main Carriers: Steel, not less than 0.0209-inch (0.53-mm) nominal thickness, cold-rolled sheet, with factory-applied protective coating, complying with ASTM C 635/C 635M.
 - a. Electrolytic Zinc-Coated Steel: ASTM A 879/A 879M, not less than 08Z (24G) zinc coating.
 - b. Hot-Dip Galvanized Steel: ASTM A 653/A 653M, not less than G60 (Z180) zinc coating.
 3. Adaptable Carriers: Manufacturer's standard carriers for direct attachment to existing suspended tees.
 4. Flexible Radial Carriers: Manufacturer's standard radial carriers.
 5. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
- H. Carrier Splices: Same metal, profile, and finish as for carriers.
- I. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

- K. Exterior Bracing: Cold-rolled steel channels and angles, hot-dip galvanized to comply with ASTM A 653/A 653M, G60 (Z180) coating designation; size and profile as required to withstand wind load.
- L. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.
- M. Attachment Clips: Manufacturer's standard attachment clip spaced as required by the manufacturer's installation requirements.
- N. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.
 - 1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.4 LINEAR METAL CEILING (Existing)

- A. Products: Provide Armstrong, Inc. Metalworks Linear or comparable products from
 - 1. United States Gypsum Company.
 - 2. CertainTeed Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
 - 1. Type and Form ASTM E1264 Classification, Class A
 - 2. Pattern: C micro-perforated
- D. Color: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
- E. Light Reflectance (LR): 0.61.
- F. Noise Reduction Coefficient (NRC): 0.85.
- G. Ceiling Attenuation Class (CAC): N/A.
- H. Edge/Joint Detail: Square Lay-in.
- I. Thickness: 5/8 inch.

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- J. Modular Size: 6 by 96 inches.
- K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 LINEAR METAL CEILING (Existing)

- A. Products: Provide Longboard Premium Soffit & Siding or comparable products from:
 - 1. United States Gypsum Company.
 - 2. CertainTeed Corporation.
 - 3. Armstrong, Inc.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
 - 1. V-Groove type, 6 inches wide.
 - 2. Pattern: Unperforated with vent soffit panels.
- D. Color: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2.7 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10.
- B. Lacquered Mill Finish: AA-M10C10R1x with manufacturer's standard clear, organic coating.

LINEAR METAL CEILINGS

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- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- G. Finish for LMC-2 shall be manufacturer's standard Alluminate certified AAMA 2606/2605 compliant, and be VOC, Chrome & Phosphate Free and TGIC Free.

2.8 GALVANIZED-STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint finish complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.9 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.
- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical, bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.10 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of linear metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and on Coordination Drawings.

3.3 INSTALLATION

- A. Comply with ASTM C 636/C 636M and seismic requirement indicated, per manufacturer's written instructions and Cisca's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
 - 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.

7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.
1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.
- G. Install linear metal pans in coordination with suspension system and exposed moldings and trim.
1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
 3. Install pans with butt joints using internal pan splices and in the following joint configuration:
 - a. Aligned.
 - b. Aligned, every other pan length.
 - c. Staggered a minimum of 12 inches (300 mm).
 - d. Random.
 - e. As indicated.
 4. Install directionally textured metal pans in directions indicated.

5. Where metal pan ends are visible, install end caps unless trim is indicated.
 6. Install filler strips where indicated.
 7. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.
- H. Install hold-down clips where indicated.
- I. For LMC-2 panels, install with manufacturer's mounting clip, using starter strips and finishing caps. Aluminum components shall be adequately isolated from galvanized steel framing members.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Suspended ceiling system.
 2. Hangers, anchors, and fasteners.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Tests and Inspections: Testing and inspecting of completed installations of linear metal ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of linear metal ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select 1 of every 2 post-installed anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Linear metal ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 095423

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient stair accessories.
 - 3. Resilient molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 4 inches (300 mm) long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.

2. Smoke Density: Less than 450 per ASTM E 662.

- B. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for resilient base.
- C. Provide 5-year unconditional warranty for installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT WALL BASE (RB-1)

- A. Products: Basis-of-Design products from Johnsonite, Inc. Traditional Rubber Base or comparable product by one of the following:
 - 1. Roppe Corporation, USA.
 - 2. VPI Corporation.
- B. Product Standard: ASTM F 1861
 - 1. Group: I (solid, homogeneous).
 - 2. Meet or exceed ASTM E 84/NFPA 225 – Class A flame spread index, less than 450 smoke density.

RESILIENT BASE AND ACCESSORIES

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3. Style:

- a. Toeless on carpeted floors
- b. Cove on resilient, concrete floors

C. Thickness: 1/8"

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Colors: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

2.2 COVE BASE (CB-1)

A. Products: Pre-fabricated Flash Cove bases. Fabricated from same material and dye lots as resilient sheet. Basis-of-Design products Altro FlashCove or comparable product by one of the following:

- 1. Roppe Corporation, USA.
- 2. VPI Corporation.

B. Metal Base Cap: For adhesive installation; stainless steel cap; "chiklet" by FlashCove Prefabricated Bases Inc.

C. Prefabricated Flash Cove Base Adhesive: Low-VOC premium cove base adhesive recommended by both flooring and prefabricated flash cove base manufacturer.

D. Concrete Moisture Emission Reducer:

- 1. Provide 1 of following:
 - a. "Poxycrete" by Duochem Inc.
 - b. "Flextech 4010 Moisture Barrier" by Flextile Ltd.
 - c. "Koester VAP I® 2000" by Koester American Corporation.
 - d. "Sikafloor® 81 EpoCem" by Sika Corporation, USA.

2.3 RUBBER MOLDING ACCESSORY

A. Products: Refer to profile type for Basis-of-Design or select comparable product by one of the following:

1. Roppe Corporation, USA.
2. VPI Corporation
3. Johnsonite

B. Description: Rubber carpet edge for glue-down applications reducer strip for resilient flooring.

C. Profile and Dimensions: As indicated or as scheduled below.

1. Carpet edge for glue down applications (carpet to concrete, carpet to rubber): Roppe profile #38
2. Carpet to Carpet application: Johnsonite T-Moulding CD-XX-C

D. Locations: All areas where two dissimilar materials come together.

E. Colors and Patterns: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

RESILIENT BASE AND ACCESSORIES

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- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than **10** pH.
 4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Cope corners to minimize open joints.

3.4 PREFABRICATED FLASH COVE BASE INSTALLATION

- A. Prefabricated Flash Cove Base Application:
 - 1. Provide prefabricated flash cove base for integral base indicated in Finish Schedule.
 - 2. Dry-fit prefabricated flash cove base; cut and fit material to required lengths. Miter-cut inside and outside corners.
 - 3. Dry-fit and cut metal cove cap prior to prefabricated flash cove base installation.
 - 4. Scribe glue line on walls and floor at edge of prefabricated flash cove base material.
 - 5. Apply adhesive in full spread (100% coverage on 2 surfaces) for full length of prefabricated flash cove base material. Apply prefabricated flash cove base to wall surface straight and level.
 - 6. Slide metal base cap behind prefabricated flash cove base material.
 - 7. Hand roll prefabricated flash cove base material onto wall and floor surface removing bumps, ripples and fishmouths. Remove excess adhesive.
 - 8. weld seams as recommended by manufacturer in prefabricated flash cove base material.

3.5 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.

- 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 – RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient sheet flooring (RES-#).
- B. Related Requirements:
 - 1. Section 096513 “Resilient Base and Accessories” for resilient base and transition strips.

1.3 SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.
- E. Qualification Data: For Installer.
- F. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Resilient Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient product installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient product manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Coordinate mockups in this Section with mockups specified in other Sections.
 - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations indicated.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient products, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RESILIENT FLOORING, RES-1

- A. Basis-of-Design Product: Altro Symphonia Commercial Safety Sheet Vinyl Flooring by Altro USA, Inc.; www.altrofloors.com, or approved substitution.
- B. Material Standard: ASTM F1303, Type I, Grade 1, Class A moisture resistant backing.
- C. Slip Resistance: ASTM D2047; 0.9 dry, 0.8 wet.
- D. Size: Refer to Color and Finish Schedule on Drawings.
- E. Thickness: Overall, 0.08 inch (2.0 mm); Wear layer, 0.8mm wear layer, heterogeneous construction
- F. Color and Pattern: As specified in Color and Finish Schedule on Drawings.
- G. Application: As indicated Room Finish Schedule on Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient flooring manufacturer for resilient products and substrate conditions indicated.
- C. Threshold: Provide stainless steel threshold at Refrigerator and Freezer doors for transition from RES-1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. Perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

- D. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE AND ACCESSORY INSTALLATION

- A. As specified in Section 096513 "Resilient Base and Accessories."

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096516

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes modular carpet tile.
- B. Related Requirements:
 - 1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Carpet tile type, color, and dye lot.
 - 2. Type of subfloor.
 - 3. Type of installation.
 - 4. Pattern of installation.
 - 5. Pattern type, location, and direction.
 - 6. Pile direction.
 - 7. Type, color, and location of edge, transition, and other accessory strips.
 - 8. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockups at locations and in sizes shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weather-tight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-1 & CPT-2)

- A. Products: Basis-of-Design products from Interface, Harmonize/Groundwaves or comparable by one of the following
 - 1. Patcraft.
 - 2. Mannington Mills, inc.
- B. Generally retain "Color" and "Pattern" paragraphs below unless they are described by product designation inserted above.
- C. Color: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
- D. Pattern: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
- E. Fiber Content: 100% Recycled content Type 6 Nylon
- F. Product Construction: Tufted texture loop.
- G. Pile Characteristic: loop.
- H. Pile Thickness: 0.106 inches for finished carpet tile according to ASTM D 6859.
- I. Total Thickness: 0.26 inches.
- J. Surface Pile Weight: 16 oz./sq. yd.
- K. Pile Density: 5,434 oz/sq. yd.
- L. Primary Backing/Back-Coating: Manufacturer's standard composite materials.
- M. Backing System: GlasBacRE®.
- N. Size: 25cm x 1m.
- O. Performance Characteristics:
 - 1. Flooring Radiant Panel: Passes according to ASTM E-648.
 - 2. Traffic Classification: Heavy
 - 3. Flammability: Passes Methenamine Pill Test (DOC-FF1-70).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine carpet tile for type, color, pattern, and potential defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: None (will be used as loose carpet squares/area rugs in classrooms).
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Install pattern parallel to walls and borders.

3.3 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove yarns that protrude from carpet tile surface.
 - 2. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates. All labor, materials, tools and other equipment, services and supervision required to complete all exterior painting and decorating work as indicated on Finish Schedules and to the full extent of the Drawings and Specifications. Exterior paint systems will be utilized for exterior substrates.
- B. Related Requirements:
 - 1. Division 5 Section "Structural Steel Framing".
 - 2. Division 5 Section "Metal Fabrications".
 - 3. Division 8 Section "Hollow Metal Doors and Frames".
 - 4. Division 8 Section "Door Hardware" for preparation prior to finishing of existing doors and frames to remain.
 - 5. Division 9 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
 - 6. Division 9 Section "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on exterior wood substrates.

1.2 DEFINITIONS

- A. Gloss Level 1: Matte or Flat Finish: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: Eggshell Finish: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: Satin Finish: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: Semi-Gloss Finish: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: Gloss Finish: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: High Gloss Finish: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 REFERENCES

A. ASTM International:

1. ASTM C834 – Latex Sealing Compounds.
2. ASTM D16 – Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
3. ASTM D4442 – Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. Architectural Painting Specification Manual by the Master Painters Institute (MPI), including Evaluation, Systems, Preparation and Approved Product List (MPI Manual).

C. Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

1.4 SYSTEM DESCRIPTION

A. Painting and finishing shall include all coating systems materials, including primers, emulsions (except asphalt based), enamels, stains, sealers and fillers and other applied materials, whether used as prime, intermediate or finish coats.

B. Materials to Be Finished:

1. Unless otherwise indicated in documents, all Work receives painting and finishing. Consult Drawings, Schedules, and other Specification Sections for complete requirements. Where materials required to be finished are not indicated in the Finish Schedule or Drawings, refer to the MPI Manual for the appropriate finish; provide premium grade finish.
2. Existing construction receives painting and finishing as indicated. Consult Drawings, Schedules, and other Specification Sections for complete requirements. Where materials required to be finished are not indicated in the Finish Schedule or Drawings, refer to the MPI Manual for the appropriate finish; provide premium grade finish.

C. Materials Not to Be Finished:

1. Finished metal surfaces of anodized aluminum, polyvinylidene fluoride (PVDF), stainless steel, chromium plate, copper, bronze and similar finished metals will not require finish painting, except as indicated otherwise.
2. Glass and plastic, except as noted otherwise.
3. Materials having complete factory finish or that require installer finishing, except as indicated otherwise. Shop priming of ferrous metal items and shop-fabricated components is included under various Sections.
4. Walls and ceilings in concealed and generally inaccessible areas, above suspended ceilings, furred areas, pipe spaces, duct shafts, and the like.
5. Acoustical ceiling tile and their suspension systems, unless indicated otherwise.
6. Concrete floors, except as indicated to be painted.

7. CMU walls, except as indicated on Drawings to be painted.
8. Moving parts of operating units, moving parts of mechanical and electrical units, linkages, sensing devices, motor and fan shafts, and the like.
9. Code-required labels such as Underwriter's Laboratories, Factory Mutual, and Warnock-Hershey or any equipment identification, performance rating, name or nomenclature plates, and the like.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 1. Submit Samples on rigid backing, 8 inches square.
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. VOC content.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Quality Standard:
 1. Work of this Section shall conform to not less than the minimum standards for material and Work including inspection and warranty requirements set forth in the MPI Manual.
 2. Work of this Section shall be of the grade and finish system in Accordance with the MPI as indicated in Painting and Finishing Schedule in Part 3 of this Section.
- B. Qualifications:
 1. Product Manufacturers: As listed in PART 2 of this Section. No substitutions.

C. Regulatory Requirements:

1. Comply with applicable federal, state, and local requirements and publications pertaining to environmental protection and the protection of the health and safety of workers, visitors to the site, and persons occupying the Project Site.
2. Where conflict among requirements or with this specification exists, the most stringent shall govern.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Perform no exterior painting work unless environmental conditions are within MPI and paint manufacturer's requirements or until adequate weather protection is provided. Where required, suitable weatherproof covering and sufficient heating facilities shall be in place to maintain minimum ambient air and substrate temperatures for 24 hours before, during and after paint application.
- C. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3° C) above the dew point; or to damp or wet surfaces.
- D. Perform no painting or decorating work when the maximum moisture content of the substrate exceeds:
- a. 15% for wood.
 - b. 12% for plaster and gypsum board.
- E. Conduct all moisture tests using a properly calibrated electronic Moisture Meter.

1.10 SPECIAL PROJECT WARRANTY

- A. Warranty: Furnish a 100% two (2) year Maintenance Bond. The Maintenance Bond shall warrant that all painting work has been performed in accordance with accepted industry quality standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The Sherwin Williams Company (Basis of Design).
- B. The following manufacturers will be considered for substitution subject to compliance with procedures specified in Section 012500 Product Requirements, and the properties specified for each product in the PART 3 EXTERIOR PAINTING SCHEDULE.
 - 1. Benjamin Moore.
 - 2. PPG.

2.2 PAINT, GENERAL

- A. Materials:
 - 1. All materials used on this job (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc.) shall be from a single source manufacturer for each system used.
 - 2. Other materials such as linseed oil, shellac, thinners, solvents, etc., shall be the highest quality product, compatible with paint materials being used as required.
 - 3. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

2.3 EQUIPMENT

- A. Painting and Decorating Equipment: To best trade standards for type of product and application.
- B. Spray Painting Equipment: Of ample capacity, suited to the type and consistency of paint or coating being applied and kept clean and in good working order at all times.

2.4 MIXING AND TINTING

- A. Unless otherwise specified herein or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and color and gloss uniformity.
- B. Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- C. Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.

- D. If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

2.5 FINISH AND COLORS

- A. Refer to Color and Material Schedule and Drawings for identification and location of colors.

2.6 GLOSS AND SHEEN RATINGS:

- A. As indicated in Part 3 of these Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Portland Cement Plaster: 12 percent.
 - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- G. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and dust off.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Exterior Mechanical and Electrical Equipment:
 - 1. General: Exterior painting and finishing of mechanical and electrical items includes all exposed items whether factory-finished or not.
 - 2. Additional painting and finishing of mechanical and electrical items is indicated in Divisions 23 and 26.

3.4 FIELD QUALITY CONTROL

- A. Tolerances: Final application shall match color and texture of approved samples and shall be smooth, uniform in appearance, color, texture, sheen, and shall be free of runs, sags, holidays, lap marks, air bubbles, pin holes, and other detrimental effects in accordance with requirements of the MPI and this Specification.
- B. Inspection and Testing:
 - 1. Provide and pay for inspection and testing of the Work of this Section in accordance with the warranty provisions of the MPI.
 - 2. Inspection Agency's Duties:
 - a. Provide qualified personnel at Project Site. Cooperate with Architect and Contractor in performance of services.
 - b. Perform required inspection, sampling, and testing of Products and applications and ascertain compliance with requirements of MPI.
 - c. After each inspection and test, submit 1 copy of written report within 5 calendar days to Architect and Contractor. Include in each report the Project title, date of report, date and time of inspection, weather conditions during visit, name of inspector, identification of Product and substrate, location in Project, type of inspection or test, results of tests, and whether results indicate conformity with Contract Documents.
 - d. Promptly notify Architect and Contractor in writing of observed irregularities or non-conformity of workmanship or Projects. When requested by Architect, provide interpretation of test results, evaluation of analysis of cause (in event of test failure), and recommendations for remedial action.

3. Inspection Agency's Limitations:

- a. Inspection Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- b. Inspection Agency may not approve or accept any portion of the Work for Owner or Architect.
- c. Inspection Agency may not assume duties of Contractor or Applicator.
- d. Inspection Agency has no authority to stop the Work.

4. Applicator's Duties:

- a. Pay inspection fees associated with inspection and warranty requirements set forth in MPI.
- b. Notify inspection agency not less than 10 full working days prior to beginning Work of this Section.
- c. Notify inspection agency not less than 2 full working days prior to expected time for operations requiring inspection or testing services.
- d. Allow full access to the Work. Cooperate with inspection and testing personnel in performance of their duties of inspecting and testing of Work.
- e. Provide incidental labor and facilities to provide access to Work to be inspected or tested. Repair destructive testing sites.
- f. Correct deficiencies noted by Inspection Agency.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Structural Steel and Metal Fabrications (including steel doors and frames):
 - 1. Two Alkyd Coats (over alkyd primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Kem Kromik Universal Metal Primer B50WZ1.

- b. Finish: S-W Direct-to-Metal Enamel Alkyd Semi-Gloss B55 Series.
- B. Galvanized-Metal Substrates (including metal deck and hollow metal frames):
 - 1. Two Alkyd Coats (over acrylic primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Kem Kromik Univeral Metal Primer B50WZ1.
 - b. Finish: S-W Direct-to-Metal Enamel Alkyd Semi-Gloss B55 Series.
- C. Aluminum:
 - 1. Two Alkyd Coats (over wash primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W DTM Wash Primer, B71Y1.
 - b. Finish: S-W Direct-to-Metal Enamel Alkyd Semi-Gloss B55 Series.
- D. Dressed Lumber: to be Painted (including fascia boards, wood doors, frames and window trim).
 - 1. Two, 100% Acrylic Coats (over alkyd primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Exterior Oil-Based Wood Primer, Y24 Series.
 - b. Finish: S-W Solo 100% Acrylic Int/Ext Semi-Gloss, A76 Series.
- E. Wood Paneling: to be Stained, (siding and soffits).
 - 1. Two Coats: Stain, exterior, solvent based, semi-transparent.
 - 2. Finish Sheen: Gloss Level 1.
 - a. Finish: S-W SuperDeck Oil-Base Semi-Transparent Stain.
- F. Plastic (ABS, PVA, PVC materials, fabrications, etc.):
 - 1. Two, 100% Acrylic Coats (over acrylic adhesion promoting primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Multi-Purpose Latex Primer B51-450 Series.
 - b. Finish: S-W Solo 100% Acrylic Int/Ext Semi-Gloss, A76 Series.
 - 3. Finish Sheen: Gloss Level 5.
- G. Lumber siding: to be Stained, (cedar).
 - 1. Two Coats: Stain, exterior, solvent based, semi-transparent.
 - 2. Finish Sheen: Gloss Level 1.
 - a. Finish: S-W SuperDeck Oil-Base Semi-Transparent Stain.

H. Cement Board Substrates:

1. Two, 100% Acrylic Coats (over acrylic primer).
2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Loxon Concrete & Masonry Primer A24W8300, (unless factory primed)
 - b. Finish: S-W Solo 100% Acrylic Int/Ext Semi-Gloss, A76 Series

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates. All labor, materials, tools and other equipment, services and supervision required to complete all interior painting and decorating work as indicated on Finish Schedules and to the full extent of the Drawings and Specifications. Interior paint systems will be utilized for interior substrates.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for preparation prior to finishing of existing doors and frames to remain
 - 2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.2 DEFINITIONS

- A. Gloss Level 1: Matte or Flat Finish: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: Eggshell Finish: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: Satin Finish: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: Semi-Gloss Finish: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: Gloss Finish: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: High Gloss Finish: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C834 – Latex Sealing Compounds.
 - 2. ASTM D16 – Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.

3. ASTM D4442 – Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-base Materials.
- B. Architectural Painting Specification Manual by the Master Painters Institute (MPI), including Evaluation, Systems, Preparation and Approved Product List (MPI Manual).
- C. Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings) of the Environmental Protection Agency (EPA).

1.4 SYSTEM DESCRIPTION

- A. Painting and finishing shall include all coating systems materials, including primers, emulsions (except asphalt based), enamels, stains, sealers and fillers and other applied materials, whether used as prime, intermediate or finish coats.
 1. Materials to Be Finished:
 - a. Unless otherwise indicated in documents, all Work receives painting and finishing. Consult Drawings, Schedules, and other Specification Sections for complete requirements. Where materials required to be finished are not indicated in the Finish Schedule or Drawings, refer to the MPI Manual for the appropriate finish; provide premium grade finish.
 2. Materials Not to Be Finished:
 - a. Finished metal surfaces of anodized aluminum, polyvinylidene fluoride (PVDF), stainless steel, chromium plate, copper, bronze, and similar finished metals will not require finish painting, except as indicated otherwise.
 - b. Glass and plastic, except as noted otherwise.
 - c. Materials having complete factory finish or that require installer finishing, except as indicated otherwise. Shop priming of ferrous metal items and shop-fabricated components is included under various Sections.
 - d. Walls and ceilings in concealed and generally inaccessible areas, above suspended ceilings, furred areas, pipe spaces, duct shafts, and the like.
 - e. Acoustical ceiling tile and their suspension systems, unless indicated otherwise.
 - f. Concrete floors, except as indicated to be painted.
 - g. CMU except where indicated to be painted.
 - h. Moving parts of operating units, moving parts of mechanical and electrical units, linkages, sensing devices, motor and fan shafts, and the like.
 - i. Code-required labels such as Underwriter's Laboratories, Factory Mutual, and Warnock-Hershey or any equipment identification, performance rating, name or nomenclature plates, and the like.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. VOC content.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Quality Standard:
 - 1. Work of this Section shall conform to not less than the minimum standards for material and Work including inspection and warranty requirements set forth in the MPI Manual.
 - 2. Work of this Section shall be of the grade and finish system in accordance with the MPI as indicated in Painting and Finishing Schedule in Part 3 of this Section.
- B. Qualifications:
 - 1. Product Manufacturers: As listed in MPI and Color and Material Schedule in Drawings. No substitutions.
 - 2. Applicator: Company specializing in and regularly engaged in performing Work of this Section with not less than three (3) years experience. Maintain regular work force of qualified journey-level personnel, trained, skilled, and experienced in performing required Work and constant competent supervision. Apprentices may be employed working under qualified journeymen's directions in accordance with trade regulations.

C. Regulatory Requirements:

1. Comply with applicable federal, state, and local requirements and publications pertaining to environmental protection and the protection of the health and safety of workers, visitors to the site, and persons occupying the Project Site.
2. Where conflict among requirements or with this specification exists, the most stringent shall govern.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Perform no interior painting or decorating work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above minimum requirements for 24 hours before, during and after paint application. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
- C. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- D. Apply paint only to dry, clean, properly cured and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.
- E. Perform no painting or decorating work unless a minimum lighting level of 323 Lux (30 foot candles) is provided on surfaces to be painted or decorated. Adequate lighting facilities shall be provided by the General Contractor.
- F. Perform no painting or decorating work when the maximum moisture content of the substrate exceeds:
1. 15% for wood.
 2. 12% for plaster and gypsum board.
- G. Conduct all moisture tests using a properly calibrated electronic moisture meter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. As listed in the INTERIOR PAINTING SCHEDULE.
 - 1. Sherwin Williams (Basis-of-Design).
 - 2. Benjamin Moore (Basis-of-Design).
 - 3. Rodda Paint Company.
 - 4. Miller Paint.
- B. The following manufacturers will be considered for substitution subject to compliance with procedures specified in Section 016000 PRODUCT REQUIREMENTS and the properties specified for each product in the PART 3 INTERIOR PAINTING SCHEDULE.
 - 1. PPG.

2.2 PAINT, GENERAL

- A. Materials:
 - 1. Only materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, etc) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project. All such material shall be from a single source manufacturer for each system used.
 - 2. Other materials such as linseed oil, shellac, thinners, solvents, etc shall be the highest quality product of an MPI listed manufacturer and shall be compatible with paint materials being used as required.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.
 - 9. Shellacs, Clear: 730 g/L.
 - 10. Shellacs, Pigmented: 550 g/L.

2.3 EQUIPMENT

- A. Painting and Decorating Equipment: To best trade standards for type of product and application.
- B. Spray Painting Equipment: Of ample capacity, suited to the type and consistency of paint or coating being applied and kept clean and in good working order at all times.

2.4 MIXING AND TINTING

- A. Unless otherwise specified herein or pre-approved, all paint shall be ready-mixed and pre-tinted. Re-mix all paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and color and gloss uniformity.
- B. Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- C. Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- D. If required, thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Consultant.

2.5 FINISH AND COLORS

- A. Unless otherwise specified herein, all painting work shall be in accordance with MPI Premium Grade finish requirements.
- B. Refer to Color and Material Schedule and Drawings for identification and location of colors.
- C. Except as noted herein or indicated in the Color and Material Schedule, interior walls and ceiling surfaces shall be painted in accordance with the following criteria over appropriate prime / sealer coat:
 - 1. All areas (except as noted): washable latex with GL3 (eggshell) finish.
 - 2. Laundry facilities / rooms, public wash / shower / bathrooms: washable latex with G5 (semi-gloss) finish.
 - 3. Public change / wash / shower rooms with institutional facility bathing and shower rooms: G5 (semi-gloss) finish for wet surfaces.
 - 4. Public and institutional facility "clean" or "sanitary" areas such as food preparation and laboratory areas: G5 (semi-gloss) finish for dry surfaces.
- D. Access doors, prime coated butts, and other prime coated hardware, registers, radiators and covers, exposed piping and electrical panels shall be painted to match adjacent surfaces (i.e. same color, texture and sheen), unless otherwise noted or where pre-finished.

- E. Plywood service panels (e.g. electrical, telephone, and cable vision panels) including edges shall be back-primed and painted to match painted wall mounted on.
- F. The inside of light valances shall be painted gloss white.
- G. The inside of all duct work behind louvers, grills and diffusers for a minimum of 18" (460 mm) or beyond sight-line, whichever is greater, shall be painted using flat black (non-reflecting) paint.

2.6 GLOSS AND SHEEN RATINGS

- A. As indicated in Part 3 of these Specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Portland Cement Plaster: 12 percent.
 - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

INTERIOR PAINTING

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1. Carefully clean and replace all such items upon completion of painting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes).
 2. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Protect all adjacent interior surfaces and areas, including rating and instruction labels on doors, frames, equipment, piping, etc., from painting operations and damage with drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.
- E. Substrate defects shall be made good and sanded by others ready for painting particularly after the first coat of paint. Start of finish painting of defective surfaces (e.g. gypsum board) shall indicate acceptance of substrate and any costs of making good defects shall be borne by the painter including re-painting of entire defective surface (no touch-up painting).
- F. Wood Substrates:
1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations.
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

- A. Tolerances: Final application shall match color and texture of approved samples and shall be smooth, uniform in appearance, color, texture, sheen, and shall be free of runs, sags, holidays, lap marks, air bubbles, pin holes, and other detrimental effects in accordance with requirements of the MPI and this Specification.
- B. Inspection and Testing:
 - 1. Provide and pay for inspection and testing of the Work of this Section in accordance with the warranty provisions of the MPI.
 - 2. Inspection Agency's Duties:
 - a. Provide qualified personnel at Project Site. Cooperate with Architect and Contractor in performance of services.
 - b. Perform required inspection, sampling, and testing of Products and applications and ascertain compliance with requirements of MPI.
 - c. After each inspection and test, submit 1 copy of written report within 5 calendar days to Architect and Contractor. Include in each report the Project title, date of report, date and time of inspection, weather conditions during visit, name of inspector, identification of Product and substrate, location in Project, type of inspection or test, results of tests, and whether results indicate conformity with Contract Documents.
 - d. Promptly notify Architect and Contractor in writing of observed irregularities or non-conformity of workmanship of Projects. When requested by Architect, provide interpretation of test results, evaluation of analysis of cause (in event of test failure), and recommendations for remedial action.
 - 3. Inspection Agency's Limitations:
 - a. Inspection Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - b. Inspection Agency may not approve or accept any portion of the Work for Owner or Architect.
 - c. Inspection Agency may not assume duties of Contractor or Applicator.
 - d. Inspection Agency has no authority to stop the Work.

4. Applicator's Duties:

- a. Pay inspection fees associated with inspection and warranty requirements set forth in MPI.
- b. Notify inspection agency not less than 10 full working days prior to beginning Work of this Section.
- c. Notify inspection agency not less than 2 full working days prior to expected time for operations requiring inspection or testing services.
- d. Allow full access to the Work. Cooperate with inspection and testing personnel in performance of their duties of inspecting and testing of Work.
- e. Provide incidental labor and facilities to provide access to Work to be inspected or tested. Repair destructive testing sites.
- f. Correct deficiencies noted by Inspection Agency.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Horizontal Surfaces (floors and stairs):
 1. Two water-based urethane/epoxy coats (over TBD primer).
 2. Finish Sheen: Gloss Level 5.
 - a. Primer: Same as Finish.
 - b. Finish: S-W ArmorSeal 8100, Water Based Epoxy Floor Coating, B70-8100 Series (<50 g/L VOC).
- B. Structural Steel and Metal Fabrications (columns, beams, joists, etc.):
 1. Two water-based light industrial Coats (over alkyl primer).
 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Kem Kromik Universal Metal Primer.

- b. Finish: S-W Pro Industrial Acrylic Semi-Gloss, B66 Series, (<50 g/L VOC).
- C. Galvanized Metal (doors, frames, misc. steel, pipes, overhead decking, ducts, etc.):
 - 1. Two water-based light industrial Coats (over alkyd primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Kem Kromik Universal Metal Primer.
 - b. Finish: S-W Pro Industrial Acrylic Semi-Gloss, B66 Series, (<50 g/L VOC).
- D. Galvanized Metal (hand railings, guard rails):
 - 1. Two water-based urethane coats (over alkyd primer).
 - 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W Kem Kromik Universal Metal Primer.
 - b. Finish: S-W HydroGloss Single Component W/B Urethane B65W181 Series, (<250 g/L VOC).
- E. Glue Laminated Beams and Columns:
 - 1. Three water-based coats water-based urethane varnish.
 - 2. Lightly sand between coats.
 - 3. Finish Sheen: Gloss Level 2.
 - a. Prime Coat: Same as Finish Coat
 - b. Finish: S-W Minwax Polycrylic Protective Finish 3333 (<275 g/L VOC)
- F. Dimensional Lumber (columns, beams, exposed joists, underside of decking, etc.):
 - 1. Three water-based coats water-based urethane varnish.
 - 2. Lightly sand between coats.
 - 3. Finish Sheen: Gloss Level 2.
 - a. Prime Coat: Same as Finish Coat.
 - b. Finish: S-W Minwax Polycrylic Protective Finish 3333 (<275 g/L VOC).
- G. Dressed Lumber (including doors, door and window frames, casings, molding, etc.):
 - 1. Three water-based coats water-based urethane varnish.
 - 2. Lightly sand between coats.
 - 3. Finish Sheen: Gloss Level 2.
 - a. Prime Coat: Same as Finish Coat.
 - b. Finish: S-W Minwax Polycrylic Protective Finish 3333 (<275 g/L VOC).
- H. Wood Paneling and Casework (partitions, panels, shelving, millwork, benches etc.):

1. Three water-based coats water-based urethane varnish.
 2. Lightly sand between coats.
 3. Finish Sheen: Gloss Level 2.
 - a. Prime Coat: Same as Finish Coat.
 - b. Finish: S-W Minwax Polycrylic Protective Finish 3333 (<275 g/L VOC).
- I. Wood Floors and Stairs (including hardwood flooring, etc.):
1. Three water-based coats water-based urethane varnish.
 2. Lightly sand between coats.
 3. Finish Sheen: Gloss Level 2.
 - a. Prime Coat: S-W Minwax Water Based Polyurethane for Floors (<250 g/L VOC) thinned 10 %.
 - b. Finish: S-W Minwax Water Based Polyurethane for Floors (<250 g/L VOC).
- J. Plaster and Gypsum (Standard Living Spaces, Class Rooms Offices, Hallways, etc.):
1. Two vinyl acrylic coats (over vinyl acrylic primer).
 2. Finish Sheen: Gloss Level 3 or 4.
 - a. Primer: S-W ProMar 200 Zero VOC Interior Latex Primer B28W02600 (Volume Solids: 26% ± 2%).
 - b. Finish: S-W ProMar 200 Zero VOC Int Latex Egg Shell, B20-2600 Series (Volume Solids: 42 ± 2%).
- K. Plaster and Gypsum (Damp areas with higher maintenance requirements including Kitchens, Toilets, and Maintenance Spaces):
1. Two water-based high performance acrylic coats (over vinyl acrylic primer).
 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W ProMar 200 Zero VOC Interior Latex Primer B28W02600 (Volume Solids: 26% ± 2%).
 - b. Finish: S-W Pro Industrial Acrylic Semi-Gloss, B66 Series, (<50 g/L VOC), (Volume Solids: 35 ± 2%).
- L. Plaster and Gypsum (Wet areas such as Shower Rooms):
1. Two solvent-based epoxy coats (over appropriate primer).
 2. Finish Sheen: Gloss Level 5.
 - a. Primer: S-W ProMar 200 Zero VOC Interior Latex Primer B28W02600 (Volume Solids: 26% ± 2%).
 - b. Finish: S-W Macropoxy 646-100 Fast Cure Epoxy B58-620 (<100 g/L VOC).

M. Exposed Ceilings:

1. S-W Pro Industrial Waterborne Acrylic Dryfall Eggshell B42W00082 (<50 g/L VOC).

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and application of wood finishes on the following substrates:
 - 1. Interior Substrates:
 - a. Dressed lumber (finish carpentry).
 - b. Exposed wood panel products.

1.3 DEFINITIONS

- A. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.
 - 1. Submit Samples on representative samples of actual wood substrates, 8 inches (200 mm) square or 8 inches (200 mm) long.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.
 - 3. VOC content.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Cabot Incorporated, Samuel.
 - 3. Diamond Vogel Paints.
 - 4. Duron, Inc.
 - 5. ICI Paints.
 - 6. PPG Architectural Finishes, Inc.
 - 7. Sherwin-Williams Company (The)

2.2 MATERIALS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

STAINING AND TRANSPARENT FINISHING

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2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. Stain Colors: As selected by Architect from manufacturer's full range

2.3 WOOD FILLERS

A. Wood Filler Paste: MPI #91.

2.4 PRIMERS AND SEALERS

A. Alkyd Sanding Sealer: MPI #102.

1. Basis-of-Design Product: PPG Architectural Finishes, Inc.; Speedhide Quick Dry Alkyd Sanding Sealer, Series 6-10.

B. Waterbourne acrylic sealer:

1. Basis-of-Design Product: Lenmar DuraLaq-WB® 1WB.10x.

2.5 STAINS

A. Stain, Semi-Transparent, for Interior Wood: MPI #90.

1. Basis-of-Design Product: PPG Architectural Finishes, Inc.; REZ Interior Wood Stain Semi-Transparent, Series 77-560.

B. Stain, Semi-Transparent for Exterior Wood: MPI #13 (check back on PPG's website, it is currently down).

2.6 POLYURETHANE VARNISHES

A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): MPI #57.

2.7 WATERBOURNE ACRYLIC CLEAR FINISH

A. Waterbourne acrylic clear finish for interior applications. Satin (Gloss Level 4).

1. Basis-of-Design Product: Lenmar DuraLaq-WB® 1WB.10x.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
 - 3. Countersink nails and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.
- D. Exterior Wood Substrates:

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1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Prime edges, ends, faces, undersides, and backsides of wood.
 - a. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.

E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
1. Use applicators and techniques suited for finish and substrate indicated.
 2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
 3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD FINISH SYSTEM SCHEDULE

A. Cedar Soffits

1. Water Based Varnish.
 - a. Stain Coat: Stain, semi-transparent for exterior wood, MPI #13.
 - b. First Intermediate Coat: Water-based varnish matching topcoat.
 - c. Second Intermediate Coat: Water-based varnish matching topcoat.
 - d. Topcoat: Varnish, water based, clear, stain (Gloss Level 4), MPI #128.

3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood/MDF and flush wood paneling:

1. Water-based Varnish System:
 - a. Surface preparation: Waterbourne acrylic sealer 2-3 mils dft. Allow to dry and sand with silicon carbide 280-320 grit sandpaper.
 - b. Finish coats: Two (2) coats: waterbourne acrylic clear finish 3-5 mils dft. Allow to dry fully and scuff sand between all coats. Do not exceed more than two topcoats (3 coats total).

B. Wood substrates (stained), non-traffic surfaces, including wood trim and doors.

1. Polyurethane Varnish over Stain System:
 - a. Stain Coat: Stain, semi-transparent, for interior wood, MPI #90.
 - b. First Intermediate Coat: Polyurethane varnish matching topcoat.
 - c. Second Intermediate Coat: Polyurethane varnish matching topcoat.
 - d. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4), MPI #57.

END OF SECTION 099300

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board assemblies.
 - 2. Magnetic Marker-Board Panels
 - 3. Tack Board/Strip

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
 - 2. Include electrical characteristics for motorized units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Include sections of typical trim members.
- C. Samples for Verification: For each type of visual display unit indicated.
 - 1. Visual Display Panel: Not less than 8-1/2 by 11 inches (215 by 280 mm), with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
 - 2. Trim: 6-inch- (150-mm-) long sections of each trim profile.
 - 3. Display Rail: 6-inch- (150-mm-) long section of each type.
 - 4. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display units. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weather-tight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years
 - 3. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 VISUAL DISPLAY BOARD ASSEMBLY (MB-1, MB-2, MB-3)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Claridge Products and Equipment, Inc.
 - 2. ADP Lemco, Inc.
- B. Visual Display Board Assembly Factory fabricated.
 - 1. Product: Claridge Porcelain Enamel Marker Walls - Porcelain Enamel laminated panels with matched butt joints and steel splines (Basis-of-Design)
 - 2. Face Sheet: LCS³ Porcelain Enamel Steel Skin
 - 3. Core: 7/16" MDF core
 - 4. Backer: Standard Moisture Barrier Backing
 - 5. Laminations (where required): Shall be hot-type neoprene contact adhesive applied to both surfaces automatically. Each substrate shall have a minimum of 80% covering with 1.5-2.0 dry mils of adhesive. Panel components shall have uniform pressure applied mechanically over entire area. Laminations shall be made by face sheet manufacturer
 - 6. Corners: Square.
 - 7. Size: As indicated on Drawings.
 - 8. Color: As indicated on Drawings
 - 9. Mounting Method: MW2 - LCS Markerwall system with matched butt joints and No. 18 Adhesive
 - 10. Frame: Aluminum J-Trim.
 - 11. Frame depth: To match depth of marker-board.

- C. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings. Factory Assembled. Center field panels to be 48" widths to provide factory porcelain edges, outside panels to be cut only on outside edge where covered by J-Trim. Cut edges with chipping are not acceptable at butted joints.

2.4 VISUAL DISPLAY BOARD ASSEMBLY (TBD-1, TBD-3)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Forbo
 - 2. Claridge Products and Equipment, Inc.
 - 3. ADP Lemco, Inc.
- B. Visual Display Board Assembly Factory fabricated.
 - 1. Product: 800 Series Tack-Board by Claridge (Basis-of-Design)
 - 2. Assembly: tack-board with aluminum trim
 - 3. Corners: Square.
 - 4. Width: As indicated on Drawings.
 - 5. Height: 4 feet (122 cm).
 - 6. Mounting Method: Direct to wall.
 - 7. Frame: Aluminum Channel trim.
 - 8. Frame depth: To match depth of tack-board.
- C. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
- D. Chalk Tray: Manufacturer's standard; continuous.
 - 1. No tray at bottom edge. Magnetic tray at each wall

2.5 TACK STRIP ASSEMBLY (TBD-2)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Forbo
 - 2. Claridge Products and Equipment, Inc.
 - 3. ADP Lemco, Inc.
- B. Visual Display Board Assembly Factory fabricated.
 - 1. Product: Forbo Bulletin Board Cord
 - 2. Assembly: Tack-Board with aluminum trim

3. Corners: Square.
 4. Width: 4' Wide Roll
 5. Height: As indicated on Drawings.
 6. Color: As indicated on Drawings
 7. Thickness: 1/4"
 8. Mounting Method: Direct glue adhered to properly prepared GWB wall surfaces where indicated. GWB surface to be minimum level 4 finish with primed/sealed surfaceFrame: Aluminum angle trim.
 9. Frame: All edges to be trimmed with clear satin anodized aluminum J-Trim. PBS Supply Co. #E704 or equal.
 10. Frame depth: To match depth of tack-board.
- C. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.
- D. Adhesives for Field Application: Mildew-resistant, non-staining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
 1. Adhesives shall have a VOC content of 50 g/L or less.

2.7 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of motorized, sliding visual display units.
- C. Examine walls and partitions for proper preparation and backing for visual display units.
- D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations indicated on Drawings; mounting heights are to be coordinated with the Owner. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.

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- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101423 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Room-identification signs.
 - 2. Plaques

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 - 4. Show sign locations on floor plan.

- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Graffix.
 2. ASI.
 3. InPro Corporation (IPC).
 4. 290 Sign Systems.
- B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Laminated-Sheet Sign: face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: 0.125 inch (3.18 mm).
 - b. Color(s): As selected by Architect from manufacturer's full range.
 2. Solid Acrylic Sign:
 - a. Sheet Thickness: 3/8".
 - b. Color(s): As selected by Architect from manufacturer's full range.
 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Beveled.
 - b. Corner Condition in Elevation: Rounded to radius indicated.
 4. Mounting: Surface mounted to wall or glass with adhesive.
 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Matte Clear Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

2.6 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

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3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls according to accessibility standard.
- C. Mounting Methods:
 - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 SCHEDULE

- A. Reference Signage Schedule in drawings for sign types and signage messages.

END OF SECTION 101423

SECTION 102238 - OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated, acoustical panel partitions.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
 - 2. Section 092900 "Gypsum Board" for fire-rated assemblies and sound barrier construction above the ceiling at track.

1.3 DEFINITIONS

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. STC: Sound Transmission Class.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable panel partitions.
 - 1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
 - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

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1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
 1. Textile Facing Material: Full width by not less than 36-inch- (914-mm-) long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
- E. Delegated-Design Submittal: For operable panel partitions.
 1. Include design calculations for seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Partition track, track supports and bracing, switches, turning space, and storage layout.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems are attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. HVAC ductwork, outlets, and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Smoke detectors.
 - f. Access panels.
- B. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:
 1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
 2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.
- C. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
 - b. Seals, hardware, track, track switches, carriers, and other operating components.
 - c. Electric operator and controls.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of operable panel partitions.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified."
- C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
 - 1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
- D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 OPERABLE ACOUSTICAL PANELS

- A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
 - 1. Manufacturers: Subject to compliance with requirements, manufacturers are limited to:
 - a. Panelfold.
 - b. Modernfold, Inc.; a DORMA Group company.
 - c. Product Master.

- B. Panel Operation: Manually operated individual.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
 - 1. Panel Width: As indicated.
- E. STC: Not less than 56.
- F. Panel Weight: 10 lb/sq. ft. (50 kg/sq. m).
- G. Panel Thickness: Not less than 4 inches (102 mm) Panel Materials:
- H. Panel Materials:
 - 1. Gypsum Board: ASTM C 1396/C 1396M.
 - 2. Cement Board: ASTM C 1288.
 - 3. Particleboard: ANSI A208.1.
 - 4. Medium-Density Fiberboard: ANSI A208.2.
 - 5. Plywood: DOC PS 1.
- I. Panel Closure: Manufacturer's standard unless otherwise indicated.
 - 1. Hinges: Manufacturer's standard Concealed.

2.3 SEALS

- A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
 - 1. Manufacturer's standard seals unless otherwise indicated.
 - 2. Seals made from materials and in profiles that minimize sound leakage.
 - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking steel astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.

- D. Horizontal Bottom Seals: Manufacturer's standard continuous-contact seal exerting uniform constant pressure on floor.

2.4 PANEL FINISH FACINGS

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.
 - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with invisible seams complying with Shop Drawings for location, and with no gaps or overlaps. Horizontal butted edges seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
 - 2. Match facing pattern 72 inches (1830 mm) above finished floor.
- B. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
 - 1. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
 - 2. Color/Pattern: As selected by Architect from manufacturer's full range.
- C. Trimless Edges: Fabricate exposed panel edges so finish facing wraps uninterrupted around panel, covering edge and resulting in an installed partition with facing visible on vertical panel edges, without trim, for minimal sightlines at panel-to-panel joints.

2.5 SUSPENSION SYSTEMS

- A. Tracks: Steel mounted directly to overhead structural support with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch (2.54 mm) between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
 - 1. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

- D. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals

3.3 ADJUSTING

- A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Verify that safety devices are properly functioning.

3.4 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components,

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lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102238

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Corner guards.
- 2. Wall cladding.

- B. Related Requirements:

- 1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

- B. Detail Drawings: mounting details with the appropriate adhesives for specific project substrates

- C. Samples: For plastic paneling, in manufacturer's standard sizes.

- D. Manufacturer's Installation instruction: Printed Installation instructions

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to **2** < percent of each type, color, and texture of cover installed, but no fewer than four, 48-inch- (1200-mm-) long units.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS (CG)

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Manufacturers: Subject to compliance with requirements, provide products from one of the following:
 - a. American Floor Products, Inc.
 - b. Babcock-Davis.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. InPro Corporation (IPC).
 - f. Nystrom.
 - 2. Material: Stainless-steel sheet, Type 304.
 - a. Thickness: Minimum 0.0625 inch (1.6 mm).
 - b. Finish: Directional satin, No. 4.

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3. Wing Size: Nominal 1-1/2 by 1-1/2 inches (90 by 90 mm.)
4. Corner Radius: 1/8 inch (3 mm).
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

B. WALL CLADDING (WC-1)

1. Manufacturers: Basis of Design Inpro Sani-Surface Hygienic Wall Cladding. Subject to compliance with requirements, provide products from one of the following
 - a. Inpro Corporation.
 - b. Altro.
 - c. Marlite.
 - d. Crane Composites.
2. Material: Vinyl: Sani-Surface Hygienic Wall Cladding shall be manufactured from 100% chemical and stain resistant polyvinyl chloride. No plasticizers shall be added (plasticizers may aid in bacterial growth).
3. Accessories: Top caps, inside corners, divider bars and outside corners shall be made of extruded PVC.
4. Finishes: per construction drawings, surface shall have a velvet texture.

2.4 MATERIALS

- A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine areas and conditions in which product will be installed. Complete all finish operations, including painting before beginning installation of materials.
 - 3. Wall surface shall be dry and free from dirt, grease and loose paint.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. For Wall Cladding:
 - 1. Adhere to substrate with Titebond GREENchoice Fast Grab FRP Construction, a freeze-thaw stable, nonflammable, high strength, water based adhesive that trowels on and allows approximately 20 minutes working time before firming
 - 2. Adhere to substrate with Titebond Advanced Polymer, a freeze-thaw stable, nonflammable, high strength, water based adhesive that trowels on and allows approximately 20 minutes working time before firming.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Underlavatory guards.
4. Custodial accessories.
5. Warm-air dryers.

- B. Related Requirements:

1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.4 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

- 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, visible silver spoilage defects.
 - 2. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

- A. Owner-Furnished Materials: See owner Furnished Material & Equipment Schedule.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser: OFCI:
- C. Paper Towel Dispenser: OFCI:
- D. Waste Receptacle OFCI:
- E. Liquid-Soap Dispenser OFCI:
- F. Grab Bar (GB):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/4 inches (32 mm).
5. Configuration and Length: As indicated on Drawings.

G. Seat-Cover Dispenser OFCI:

H. Mirror Unit (MR):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Frame: Stainless-steel channel.
 - a. Corners: Mitered and mechanically interlocked.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Size: As indicated on Drawings.

2.3 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
- B. Diaper-Changing Station:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Diaper Deck & Company, Inc.
 - c. Koala Kare Products.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support minimum of 250-lb (113-kg) static load when opened.
3. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard color.
6. Liner Dispenser: Built in.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard As indicated on drawings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Plumberex Specialty Products, Inc.
 - b. Truebro by IPS Corporation.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Utility Shelf (US):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches (406 mm) long by 6 inches (152 mm) deep.
4. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).

C. Mop and Broom Holder (MBH):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Bobrick Washroom Equipment, Inc.
 - c. Bradley Corporation.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 30 inches (914 mm).
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.
 - b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.6 Warm-Air Dryer (Hand Dryer)

A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. World Dryer. Basis of Design: Model A Series/Stock #DA5-974
2. Description: Standard-speed, warm-air hand dryer.
3. Mounting: Surface mounted.
4. Operation: Touch-button activated with timed power cut-off switch.
 - a. Operation Time: 30 to 40 seconds.
5. Cover Material and Finish: Steel, with white enamel finish.
6. Electrical Requirements: 115 V, 20 A, 2300 W.

2.7 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for the following:
 - a. Portable fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, or semirecessed -mounting method and relationships of box and trim to surrounding construction.
- B. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.6 SEQUENCING

- A. Apply decals on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. American Specialties, Inc.
 - b. Guardian Fire Equipment, Inc.
 - c. Modern Metal Products, Division of Technico Inc.
- B. Cabinet Construction: Nonrated and 2-hour fire rated as required for installation location.
 - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet for rated cabinets or Aluminum sheet for non-rated.
- D. Recessed Cabinet:
 - 1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to cabinet. Provide recessed flange, of same material as box, attached to box to act as drywall bead.
 - 2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
 - 3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
- E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- F. Cabinet Trim Material: Aluminum sheet.
- G. Door Material: Aluminum sheet.

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- H. Door Style: Fully glazed panel with frame.
- I. Door Glazing: Break glass.
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide manufacturer's standard hinge permitting door to open 180 degrees.
- K. Accessories:
 - 1. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
 - 2. Door Lock: Cylinder lock, keyed alike to other cabinets.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate on cabinet.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Red.
 - 4) Orientation: Vertical.

2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
 - 3. Prepare doors and frames to receive locks.
 - 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire-protection cabinets in locations and at mounting heights indicated
 - 1. Fire-Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
 - 2. Provide inside latch and lock for break-glass panels.
 - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - b. Kidde Residential and Commercial Division.
 - c. Larsens Manufacturing Company.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.
- C. Provide 15 fire extinguishers and cabinets.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 122113 – HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Horizontal louver blinds with aluminum slats.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting horizontal louver blinds and accessories.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings: For horizontal louver blinds, include fabrication and installation details.

- C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

- D. Samples for Initial Selection: For each type and color of horizontal louver blind.

- 1. Include Samples of accessories involving color selection.

- E. Samples for Verification: For each type and color of horizontal louver blind indicated.

- 1. Slat: Not less than 12 inches (300 mm) long.
 - 2. Tapes: Full width, not less than 6 inches (150 mm) long.
 - 3. Horizontal Louver Blind: Full-size unit, not less than 16 inches (400 mm) wide by 24 inches (600 mm) long.
 - 4. Valance: Full-size unit, not less than 12 inches (300 mm) wide.

- F. Product Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Flame-Resistance Ratings: Passes NFPA 701.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

- A. Provide two (2) year warranty on materials and installation.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS (HLB-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Levolor; Riviera or comparable product by one of the following:

1. CACO Inc. Window Fashions.
2. Hunter Douglas
3. Springs Window Fashions;

- B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.

1. Width: 1 inch (25 mm).
2. Thickness: Not less than 0.008 inch (0.20 mm).
3. Spacing: Manufacturer's standard.
4. Finish: Ionized antistatic, dust-repellent, baked polyester finish.
5. Features:

- a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.

- C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.

1. Capacity: One blind(s) per headrail unless otherwise indicated.
2. Ends: Capped or plugged.
3. Manual Lift Mechanism:
 - a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
 - b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.
4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.
 - a. Tilt: Full.
 - b. Operator: Clear-plastic wand.

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- c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.
 - 5. Manual Lift-Operator and Tilt-Operator Lengths: Manufacturer's standard.
 - 6. Manual Lift-Operator and Tilt-Operator Locations: Right side or left side of headrail, dependent on window access, unless otherwise indicated.
 - 7. Integrated Headrail/Valance: Manufacturer's standard.
 - D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.
 - 1. Type: Top contoured to match crowned shape of slat.
 - E. Lift Cords: Manufacturer's standard braided cord.
 - F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.
 - 1. Type: Braided polyester jacket cord.
 - G. Valance: Manufacturer's standard.
 - H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
 - 1. Type: Overhead.
 - 2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.
 - I. Side Channels and Perimeter Light Gap Seals: Manufacturer's standard.
 - J. Colors, Textures, Patterns, and Gloss:
 - 1. Slats: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
 - 2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.
- 2.3 HORIZONTAL LOUVER BLIND FABRICATION
- A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.
 - B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch (6 mm) per side or 1/2 inch (13 mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
- C. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.
- F. Color-Coated Finish:
 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.
 1. Install mounting and intermediate brackets to prevent deflection of headrails.
 2. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

- A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

- A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.5 SCHEDULE

- A. Provide horizontal louver blinds at Admin sidelites, where noted on Drawings.

END OF SECTION 122113

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Manually operated roller shades with single rollers.
 - 2. Motor-operated roller shades with single rollers.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
 - 2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

- C. Samples for Initial Selection: For each type and color of shadeband material.

- 1. Include Samples of accessories involving color selection.

- D. Samples for Verification: For each type of roller shade.

- 1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.
 - 3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

- E. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from

Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS (SHADE-1)

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems, Inc., EuroTwill or comparable product by one of the following:
 - 1. Draper Inc.
 - 2. Hunter Douglas Contract
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Stainless steel.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Chain tensioner, sill mounted.
 - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
 - a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Roller Drive-End Location: Right or left side of interior face of shade as required for access.
 - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric at exterior windows, light-blocking at interior locations.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Color and Finish: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.
- G. Installation Accessories:
 - 1. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: Vinyl coated polyester.
 - 3. Orientation on Shadeband: Up the bolt.
 - 4. Openness Factor: 3 percent.
 - 5. Color: As indicated in Color and Materials Schedule in drawings or if not indicated, as selected by Architect from full range of industry colors.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Electrical Connections: Connect motor-operated roller shades to building electrical system.
- C. Roller Shade Locations: At exterior windows.
- D. Mount to window header per manufacturer's typical details. Align to top of mullion UNO.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

3.6 SCHEDULE

- 1. All exterior windows to receive SHADE-1. See drawings.

END OF SECTION 122413

SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:

1. Plastic-laminate-faced cabinets of stock design
2. Plastic-laminate countertops
3. Solid-surfacing-material countertops
4. Cabinet hardware.

- B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring casework.
2. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

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

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
 - 1. Indicate locations of hardware and keying of locks.
 - 2. Indicate locations of blocking and reinforcements required for installing casework.
 - 3. Include details of support framing system.
 - 4. Indicate locations of and clearances from adjacent walls, doors, windows, other building components.
- C. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.
- D. Samples: For cabinet finishes.
- E. Samples for Verification: 8-by-10-inch (200-by-250-mm) Samples for each type of finish and the following:
 - 1. One full-size finished base cabinet complete with hardware, doors, and drawers.
 - 2. One full-size finished wall cabinet complete with hardware, doors, and adjustable shelves.
 - 3. Maintain full-size Samples at Project site during construction in an undisturbed condition as a standard for judging the completed Work. Unless otherwise indicated, approved sample units may become part of the completed Work if in undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations.
 - 4. Section of countertop showing top, front edge, and backsplash construction.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- C. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: a certified participant in AWI's Quality Certification Program.
- B. Source Limitations: Obtain manufactured wood casework from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install manufactured wood casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Delamination of components or other failures of glue bond.
 - b. Warping of components.
 - c. Failure of operating hardware.
 - 2. Warranty Period: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 - 1. Manufactured Casework:

MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

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- a. LSI Corporation of America; a Sagas International company.
- b. TMI Systems Design Corporation.
- c. Skagit Architectural Millwork.
- d. Northwest Millwork

B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

2.2 CASEWORK, GENERAL

- A. Educational casework shall meet or exceed the requirements for Architectural Woodwork Institute Quality Standards Section 400B and 1600B for custom grade flush overlay constructed casework. Specific requirements set forth within this specification shall take precedence over the AWI Standard.
- B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."
 1. Designated Manufacturer: LSI Corporation of America; a Sagas International company.

2.3 MATERIALS

- A. High Pressure Plastic Laminate (PLAM-1 – PLAM-4)
 1. Plastic laminate shall meet standard of NEMA LD3-1985, and shall be of the following thickness:
 - a. Balancing Sheet: 0.020 inch.
 - b. Horizontal Surfaces: 0.050 inch.
 - c. Vertical Surfaces: 0.028 inch.
 - d. Cabinet Liner: Pressure fused laminate bonded to substrate. Color shall be manufacturer's standard almond, gray or white as selected by Architect.
 2. Manufacturers: Products indicated in Drawings are to establish the quality and aesthetic desired for this Project. Other manufacturers listed below are also acceptable, provided that they manufacture products in color and texture to match that which is selected and specified:
 - a. Formica.
 - b. Abet Laminati.
 - c. Nevamar.
 - d. Laminart.
 - e. Wilsonart.

3. Color Selection: As indicated in Color and Materials Schedule in drawings.
4. Lead Times: Allow for 4-6 weeks lead time for premium laminates
5. Edging: Provide T-molding at all exposed edges of cabinets, or cubbies UNO. T-Molding to match color of adjacent PLAM UNO.

B. Hardware:

1. Hinges:
 - a. Heavy duty, five knuckle 2-3/4-inch institutional type hinge. Mill ground, hospital tip, tight pin feature with all edges eased. Hinge to be full wrap around type of tempered steel 0.095 inch thick. Each hinge to have minimum nine screws, #7, 5/8 inch FHMS to assure positive door attachment.
 - b. One pair per door to 36 inch height. One and one-half pair over 37 inches in height. Two pairs on doors wider than 24 inches or for doors 73 inches or higher. Hinge to accommodate 13/16-inch thick laminated door, and allow 270 degree swing.
 - c. Finish to be dull chrome for fixed cabinetry.
2. Pulls: Solid aluminum wire pulls, fastened from back with two screws. Provide two pulls for drawers more than 24 inches (600 mm) wide.
 - a. Color: As selected by Architect from manufacturer's full range of colors.
3. Drawer Slides:
 - a. Provide Knappe & Vogt 8400, 4100, 6400; Fulterer FR 5000 or Accuride 3832C, 3834C, 3832CSC, 3834CSC, 2632.
 - b. File Drawer Accessory: Knappe & Vogt No. 476 follower and track assembly, or Pendaflex rack.
 - c. Paper Storage Drawers: Full extension, 3-part progressive opening slide, minimum 100 lb., zinc plated or epoxy coated at manufacturer's option.
4. Catches:
 - a. 7 lb. magnetic catch for base and wall cabinets. Provide two 7 lb. pulls at each tall cabinet door. Catch housing to be molded in color to match cabinet interior.
 - b. Where cabinet locks are indicated on pair of doors, provide both magnetic catch and thumb latch.
 - c. Do not provide catch at sliding drawers.
5. Adjustable Shelf Supports: To be twin pin design with anti tip-up shelf restraints for both 3/4-inch and 1-inch shelves. Design to include keel to retard shelf slide-off, and slot for ability to mechanically attach shelf to clip. Load rating to be minimum of 300 lbs. each support without failure. Cabinet interior sides shall be flush, without shelf system permanent projection.
6. Wardrobe Rod: To be 1-1/16-inch rod supported by flanges.
7. Coat Hooks:

- a. Ceiling Hook: Double coat hooks, mounted at bottom of cubbies as shown; Ives 580 Satin Aluminum.
- 8. Locks: To be disc tumbler lock keyed alike and master keyed. Dull chrome finish.
 - a. Hinged doors and drawers Olympus - 100DR, 200DW.
 - b. Refer to Casework General Notes for location of locks.
- 9. Grommet: Provide as shown, minimum 2-1/2-inch diameter to allow electrical wiring to extend through tops. Molded grommets and matching caps with slot for wire passage. Color/Finish: As selected by Architect from full range of industry colors.
- C. Detailed Requirements for Cabinet Construction:
 - 1. Sub-Base:
 - a. Cabinet Subbase: All fixed under-counter and tall units shall have an individual factory-applied base, separate and continuous (no cabinet body sides-to-floor), 3/4-inch-thick water resistant exterior grade plywood with concealed fastening to cabinet bottom. Ladder-type construction, of front, back and intermediates, to form a secure and level platform to which cabinets attach. Base is nominal 4 inches high unless shown otherwise. Panel to the floor or separate particle board base is unacceptable.
 - b. No levelers are permitted.
 - 2. Cabinet Top and Bottom:
 - a. Base and tall cabinet bottoms to be natural plywood, premium grade and sanded smooth, painted on concealed side as indicated on drawings.
 - b. Solid sub-top to be 3/4 inch. Furnish for all base and tall cabinets. Stretchers are unacceptable.
 - c. Wall cabinet bottoms and tops are 3/4-inch-thick.
 - d. Exterior exposed wall cabinet bottoms to be pressure fused laminate both sides. Assembly devices to be concealed on bottom side of wall cabinets.
 - 3. Cabinet Ends:
 - a. Solid plywood, premium grade with radiused on edges, sanded smooth finish. Doors to have eased corners, with a radius of 6" diameter on all four sides.
 - b. Exposed exterior cabinet ends to be natural grain of plywood, radiused and sanded smooth.
 - c. Exposed edges to be natural plywood with radius edges sanded smooth.
 - 4. Fixed and Adjustable Shelves:
 - a. Pressure fused laminated plywood two sides. Leading exposed edge of shelves to be edged with 3 mm ABS in color specified in Paragraph 2.3.C above.

- b. Thickness: 3/4-inch standard shelving to be maximum 29 inches wide. One-inch shelving is required for shelves 30 inches wide and over.
 - c. Thickness of shelves at all widths of open cabinets: 1 inch.
- 5. Cabinet Backs:
 - a. Standard cabinet back to be 1/4-inch thick, prefinished hardboard. Wall and tall cabinets are provided with a 1" x 1-3/4" mounting strip used to secure the cabinet to the wall. Exposed back on fixed or moveable cabinets is 3/4 inch particleboard with the exterior surface finished in GP28 laminate as selected.
- 6. Door and Drawer Fronts:
 - a. Plastic laminated doors and drawer fronts to be 13/16 inch thick for all hinged and sliding doors. Core material to be 3/4-inch-thick, plywood bonded on exterior with wood veneer sheet on both interior and exterior faces. Drawer fronts and hinged doors are to overlay the cabinet body. Maintain a maximum 1/8-inch reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet. Radius edges of drawer fronts 6" diameter.
 - b. Exposed edges to be radius to expose the plywood grain, sanded smooth. Corners to be machine-radiused and buffed to a consistent 3/4" radius. Both outer and inner edges of exposed edge to be machine-radiused and buffed for consistent profile.
- 7. Drawers:
 - a. Drawer fronts shall be applied to separate drawer body component sub-front. Secure drawer fronts to drawer body sub-front utilizing both glued and mechanical means of attachment.
 - b. Sides and back of drawers to be 1/2-inch thick pressure fused laminated fiberboard; sub-front same, to be 1/2-inch thick.
 - c. Exposed top edge to be 1 mm ABS, in color selected from manufacturer's standards.
 - d. Drawer bottom is plywood, 1/2-inch thick, laminated with thermally fused melamine, screwed directly to the bottom edges of the drawer box, to provide a rigid platform. Drawer bottom less than 1/2-inch thick will not be permitted.
 - e. The same 1/2-inch-thick plywood and platform construction detail is used for paper storage drawers and also include an angle retaining bar at the rear of each drawer.
 - f. All drawers shall have roller guides as specified.
- 8. Vertical and Horizontal Dividers: Tempered hardboard 1/4-inch thick, smooth both faces. Secure in cabinet with molded plastic clips.
- 9. ADA-Americans with Disabilities Act Requirements: The following special requirements shall be met, where specifically indicated on architectural plans as "ADA," or by General Note. To be in compliance with Federal Register Volume 56, No. 144, Rules and Regulations:

- a. Countertop Height: With or without cabinet below, not to exceed a height of 34 inches A.F.F., (Above Finished Floor), at a surface depth of 24 inches.
- b. Kneespace Clearance: Minimum 27 inches A.F.F., and 30 inches clear span width.
- c. 12 inch Deep Shelving, Adjustable or Fixed: Not to exceed a range from 9 inches A.F.F. to 54 inches A.F.F.
- d. Sink Cabinet Clearances: In addition to 9a., b. above, upper kneespace frontal depth to be no less than 11 inches, at a point 9 inches A.F.F., and as further described in Volume 56, Section 4.19.

D. Countertops, Typical:

1. High pressure plastic laminate bonded to 1-inch-thick plywood core except countertops with sinks. Underside to be properly balanced with heavy gauge backing sheet. Unless noted otherwise, edges to be 3 mm ABS. Provide continuous tops for counter type cabinets fixed in a line. No joints closer than 24 inches either side of sink cutout. Countertops with sinks shall have post formed tops, fabricated with moisture resistant MDF cores and have all edges of all cutouts sealed with a color-toned, water-resistant sealer.
2. Quality Standard: Comply with AWS Section 11 requirements for countertops.
3. Grade: Custom.

E. Hanging Rods and Shelf Supports: Refer to Details.

F. Workmanship:

1. All exposed exterior cabinet surfaces to be high pressure plastic laminate, colors as specified. Laminate surface/backer to core under controlled conditions, by approved and regulated laminating methods to assure a premium lamination. Natural-setting adhesives that cure through chemical reaction are required. Methods requiring heat are not allowed; "contact" methods of laminating are not allowed.
2. Cabinet parts shall be accurately machined and bored for premium grade quality joinery construction utilizing automatic machinery to insure consistent sizing of modular components.
3. End panels shall be doweled to receive bottom and top.
4. All cases shall be square, plumb and true.
5. Provide removable back panels and closure panels for plumbing access.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

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- C. Verify site dimensions of cabinet locations in building prior to fabrication.

3.2 CASEWORK INSTALLATION

- A. Install plumb, level, true and aligned with no distortions. Shim as required, using concealed shims. Where casework abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.
- B. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16 inch of a single plane. Fasten each individual cabinet to floor at toe space with fasteners spaced 24 inches on center. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor where they do not adjoin other cabinets.
 - 1. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
- C. Wall Cabinets: Securely fasten to solid supporting material and not to lath or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.
 - 1. Reinforcement of stud walls to support wall mounted cabinets will be accomplished during wall erection by trade involved; however, indicated accurate location and sizing of reinforcement is responsibility of casework installer.
- D. Install hardware uniformly and precisely after final finishing is complete. Set hinges snug and flat in mortises unless otherwise indicated. Turn screws to flat in mortises unless otherwise indicated. Turn screws to flat seat. Adjust and align hardware so that moving parts operate freely and contact points meet accurately. Allow for final field adjustment after installation.
- E. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.3 INSTALLATION OF TOPS

- A. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so there is no job site processing of top and edge surfaces.
- B. Fastenings: Use concealed clamping devices for field joints located within 6 inches of front, at back edges, and at intervals not exceeding 24 inches. Tighten in accordance with manufacturer's instructions to exert a constant, heavy clamping pressure at joints.
 - 1. Secure tops to cabinets with "Z" type fasteners or equivalent, using 2 or more fasteners at each front, end, and back.

- C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices.
 - 1. Where necessary to penetrate top with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal in chemical resistance, color, hardness, and texture to top surface.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. At material joints, use manufacturer's recommended adhesives and holding devices to provide joint widths not more than 1/16 inch wide at any location, completely filled and flush with abutting edges.
- E. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- F. Provide holes and cutouts as required for mechanical and electrical service fittings.
- G. Carefully dress joints smooth, remove any surface scratches, clean and polish entire surface.
- H. Provide scribe moldings for closures at junctures of top, curb, and splash with walls as recommended by manufacturer for materials involved. Use chemical resistant, permanently elastic sealing compound where recommended by manufacturer.
- I. Provide locks at all cabinet drawers and doors.

3.4 INSTALLATION OF SINKS

- A. Set top edge of sink unit in manufacturer's recommended chemical resistant sealing compound and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement.

3.5 INSTALLATION OF ACCESSORIES

- A. Install accessories in accordance with approved location drawings and manufacturer's installation recommendations. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely and smoothly without binding.

3.6 ADJUSTING

- A. Repair or remove and replace defective work, as directed by Architect upon completion of installation.

- B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.7 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6 mil plastic or other suitable water resistant covering over countertop surfaces. Tape to underside of countertop at minimum of 4 feet on center. Protect installed casework and fittings from damage by work of other trades.

END OF SECTION 123216