



ELMORE COUNTY
PUBLIC SERVICES BUILDING 1
2280 AMERICAN LEGION BLVD
MOUNTAIN HOME, ID 83647

PROJECT SPECIFICATIONS
DIVISIONS **00-33**

06 September 2024
GGLO Project No. 2024017.01

GGLO Design
113 S 5th St. Suite 200
Boise, Idaho 83702
(208) 953-7227
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DOCUMENT 000103
PROJECT DIRECTORY

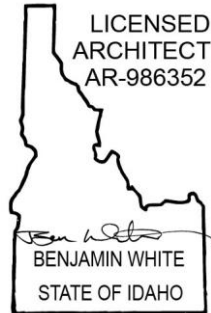
<p>OWNER</p> <p>ELMORE COUNTY CLERK 150 South 4th East Suite 3 Mountain Home, ID 83647 Contact: Shelley Essl, Clerk</p> <p>OWNER REPRESENTATIVE Elmore County Code Enforcement 520 East 2nd South Mountain Home, ID 83647 Telephone: 208.587.2142 Contact: James Roddin Direct: 208.587.2142 EXT 1290 Email: jroddin@elmorecounty.org</p> <p>MEP ENGINEERS WSP USA Buildings, Inc. 1444 S Entertainment Avenue, Suite 300 Boise, ID 83709 Contact: Richard Servoss Direct: 208-563-9122 Mobile: 208-918-2896 Email: Richard.Servoss@wsp.com</p> <p>BIDDING CONSULTANT Clearwater Financial P.O. Box 505 Eagle, ID 83616 Contact: Christine Stoll Direct: 208.800.9689 Email: cstoll@clearwaterfinancial.biz</p>	<p>ARCHITECT</p> <p>GGLO 113 S 5th Street Suite 200 Boise, ID 83702 Telephone: 208.953.7227 Contact: George Valdez Direct: 310.319.0753 Email: gvaldez@gglo.com</p> <p>HARDWARE CONSULTANT Allegion 8222 S. 48th Street, Suite 175 Phoenix, AZ 85044 Telephone: 866.494.7772 Contact: Kenneth Meloy Email: Kenneth.Meloy@Allegion.com</p>
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END OF DOCUMENT 000103

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Benjamin White
2. AR-986352.
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.



B. Plumbing Engineer:

1. Richard Servoss
2. P-22775.
3. Responsible for Division 22.



C. HVAC Engineer:

1. Richard Servoss.
2. P-22775.
3. Responsible for Division 23.



Richard J. Servoss

D. Electrical Engineer:

1. Scott Hager.
2. P-21422.
3. Responsible for Division 26.



9-5-2024

E. Telecom Engineer:

1. Scott Hager
2. P-21422
3. Responsible for Division 27

END OF DOCUMENT 000107

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NOT USED

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NOT USED

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NOT USED

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NOT USED

ELMORE COUNTY
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NOT USED

END OF DOCUMENT 000110

DOCUMENT 003100

AVAILABLE PROJECT INFORMATION

1.1 DOCUMENT INCLUDES

- A. Information that is made available to Bidders is for reference only, and is not intended to be part of the Contract.
 - 1. Existing condition information.

1.2 USE OF INFORMATION PROVIDED

- A. Bidders are encouraged to review available Project information prior to submitting a Bid, and to obtain additional information if Bidder desires.
- B. The following documents are available for viewing at the offices of Architect and Owner:
 - 1. Existing Conditions Information: Existing drawings.

1.3 EXISTING CONDITIONS INFORMATION

- A. Existing drawings that include information on existing conditions including previous construction at Project site.
 - Available through Bidding website by Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF DOCUMENT 003100

DOCUMENT 006325

REQUEST FOR SUBSTITUTION FORM

Project Name: Public Services Building 1
Project No.: 2024017.01

Date: _____
Spec Section No.: _____

To:

GGLO
113 S 5th Street, Suite 200
Boise, ID 83702

Attention: George Valdez
Telephone: 310.319.0753
Email: gvaldez@gglo.com

Contractor: _____
Requested by: _____
Phone: _____
Email: _____

Reason for not providing specified item: _____

Savings to Owner for accepting Substitution: _____

Specified Product/Fabrication Method

(List name/description; model no., manufacturer): _____

Required Information for **Specified** Product: Attached:

- | | |
|--|--|
| <input type="checkbox"/> Point by Point Comparative Product Data (<i>Required</i>) | <input type="checkbox"/> Fabrication Drawings |
| <input type="checkbox"/> Tests | <input type="checkbox"/> Samples (<i>Where Applicable</i>) |
| <input type="checkbox"/> Reports | |

Proposed Product/Fabrication Method

(List name/description; model no., manufacturer): _____

Required Information for **Proposed** Product: Attached:

- | | |
|--|--|
| <input type="checkbox"/> Point by Point Comparative Product Data (<i>Required</i>) | <input type="checkbox"/> Fabrication Drawings |
| <input type="checkbox"/> Tests | <input type="checkbox"/> Samples (<i>Where Applicable</i>) |
| <input type="checkbox"/> Reports | |

List of Related Changes/Modifications: _____

Differences between proposed substitution
and specified product: _____

Do proposed product/fabrication methods
affect other parts of Work? No Yes: Explain _____

Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equivalent or superior in all respects to specified product as utilized for this Project, except as noted herein.
- Qualifications of manufacturer, Installer, and other specified parties meet specified qualifications.
- Same special warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source for replacement parts, as applicable, is available as that specified.
- Proposed substitution does not affect dimensions and functional clearances, except as noted herein.

Contractor:

Submitted by: _____

Signed: _____

Firm: _____

Telephone: _____ Email: _____

Architect:

Submitted by: _____

Signed: _____

Telephone: _____ Email: _____

Accepted Accepted as Noted Not Accepted Received too Late

END OF DOCUMENT 006325

SECTION 011100
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Project information.
 2. Work covered by Contract Documents.
 3. Owner-furnished/Contractor-installed (OFICI) products.
 4. Contractor's use of site and premises.
 5. Work restrictions.
 6. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

- A. **Project:**
Elmore County Public Services Building 1
2280 American Legion Blvd
Mountain Home, ID 83647
- B. **Owner:**
Elmore County Clerk
150 South 4th East Suite 3
Mountain Home, ID 83647
- C. **Owner's Representative:**
Elmore County Code Enforcement
520 East 2nd South
Mountain Home, ID 83647
Telephone: 208.587.2142
Contact: James Roddin
Direct: 208.587.2142 EXT 1290
Email: jroddin@elmorescounty.org
- D. **Architect:**
GGLO
113 S 5th Street Floor 2, Boise, ID 83702
Contact: George Valdez
Direct: 310.319.0753
- E. Architect's Consultants: Architect has retained design professionals who have prepared designated portions of Contract Documents. Refer to Document 000103 – Project Directory for contact information.
- F. Digital Information Management System (DIMS): Project web-based digital information management software administered by Architect will be used for purposes of managing communication and documents during construction stage.
1. See Section 013100 – Project Management and Coordination for requirements for using Digital Information Management Software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. Work of Project is defined by Contract Documents and consists of the following:

1. Interior renovation of an existing 10,755 SF single story office building (B Occupancy, Type V construction). The property is currently zoned C3 and sits on 2.88 acres. The exterior is EIFS and cultured stone with concrete tile roof. Some repair of the exterior EIFS and minor exterior work is included in the project. Existing furnishings to be removed and stored per Owner direction by Contractor. Work indicated in Contract Documents.
 - B. Type of Contract:
 1. Project will be constructed under a single prime contract.
 - C. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing sequence, commencement, and completion dates, and move-out and -in dates of Owner's personnel for all phases of Work.
- 1.4 OWNER-FURNISHED, CONTRACTOR-INSTALLED (OFCI) PRODUCTS
- A. Owner will furnish products indicated. Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
 - B. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
 1. Provide to Contractor a list of existing elements from the site to be removed, protected and replaced after construction. All known items are existing at the project site and should be identified during the bidding process.
 - C. Contractor's Responsibilities: The Work includes the following, as applicable:
 1. Coordinate Owner items in Contractor's construction schedule.
 2. Package, handle, store, protect, and install Owner products.
 3. Make building services connections for Owner-furnished products.
 4. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 5. Repair or replace Owner-furnished products damaged following receipt.
 - D. Owner-Furnished/Contractor-Installed (OFCI) Products:
 1. Owner existing furnishings to be moved, protected and returned by Contractor. Coordinate with Owner Representative.
 2. Owner refrigerator and wall mounted TV to be removed, protected and reinstalled by Contractor.
 3. See contract documents for building elements to be removed and repurposed in accordance with the documents.
- 1.5 CONTRACTOR'S USE OF SITE AND PREMISES
- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
 - B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
 - C. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.
- 1.6 WORK RESTRICTIONS
- A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit exterior Work to normal business working hours of 7:00 a.m. to 7:00 p.m., Monday through Sunday, unless otherwise restricted by City ordinance.
 1. Interior Work: No time restrictions.
- C. Nonsmoking Building: Smoking is not permitted within building or within 25 feet of entrances, operable windows, or outdoor-air intakes.
- D. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site or within existing building is not permitted.
- E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's representative.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: Specifications use certain conventions for style of language and 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 Specifications. The words "shall," "shall be," or "shall comply with," depending on context, are implied where a colon (:) is used within a sentence or phrase.
 2. Contractor shall perform Specification requirements unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to Work of all Sections in Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in Specifications. One or more of the following are used on Drawings to identify materials and products:
 1. Terminology: Materials and products are identified by typical generic terms used in individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011100

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

1.3 ADMINISTRATIVE REQUIREMENTS

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

1.4 ACTION SUBMITTALS

- A. Proposed Products List: Submit list of proposed products, including name of manufacturer, trade name, model number, and reference standards if necessary, for each product, to Architect within 15 days after execution of Agreement.
- B. Substitution Requests: Electronically submit documentation identifying 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 any of the following forms:
 - a. Form acceptable to Owner and Architect.
 2. Documentation: Indicate compliance with requirements for substitutions and the following, as applicable.
 - a. Limit each substitution to 1 PDF copy of each request for consideration.
 - b. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - c. Coordination of information, including a list of changes or revisions needed to other parts of Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - d. Detailed comparison of significant qualities of proposed substitution with those of specified Work. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, warranties, and specific features and requirements indicated. Indicate deviations, if any, from specified Work.
 - e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - f. Samples, where applicable or requested.
 - g. Certificates and qualification data, where applicable or requested.

- h. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
 - i. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - j. Research reports evidencing compliance with building code in effect for Project from ICC-ES.
 - k. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for Work, including effect on overall Contract Time. If specified product or method of construction cannot be provided within Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - l. Cost information, including a proposal of change, if any, in Contract Sum.
 - m. Contractor's certification that proposed substitution complies with requirements in Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - n. 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 7 days of receipt of request for substitution.
- a. Prior to Bid: Architect will include approved substitutions in written addendum that will be issued to bidders.
 - 1) Proposed products not included by addendum are not acceptable.
 - 2) Acceptance of substitution request does not relieve requestor from meeting requirements, procedures, and warranties indicated in Contract Documents.
 - b. After Contract Award: Architect will notify Contractor of acceptance or rejection of proposed substitution using one of the following forms of acceptance:
 - 1) Change Order.
 - 2) Construction Change Directive.
 - 3) Architect's Supplemental Instructions for minor changes in Work.
 - c. 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 SUBSTITUTIONS

- A. Prebid Substitutions (Prior Approval):
 - 1. Instructions to Bidders (AIA Document A701) specifies time restrictions for submitting requests for substitutions during bidding period to requirements specified in this Section.
 - 2. Submittal Time Limit: To be received by Architect not less than 7 days before Bid opening.
 - 3. Consideration: Substitution will only be considered if submitted by Bidders and each request includes information listed under "Conditions" paragraphs specified below.
- B. 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 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 Work.
 - f. Requested substitution has been coordinated with other portions of Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than 1 contractor, requested substitution has been coordinated with other portions of Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- C. Substitutions for Convenience: Architect will consider substitution requests received within 60 days after Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to Contract Documents.
 - c. Requested substitution is consistent with Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of Work.
 - h. Requested substitution has been coordinated with other portions of Work.
 - i. Requested substitution provides specified warranty.
 - j. If requested substitution involves more than 1 contractor, requested substitution has been coordinated with other portions of 1 Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
 - k. When so directed by Architect, provide testing of equipment, material, or products being considered for substitution to assure compliance with Specifications, at no additional cost to Owner. If testing confirms equipment, material, or products meet requirements of specified equipment, material, or products, submit Samples to Architect for approval.
 2. The following reasons are grounds for rejection of substitution requests. Equipment, material, and products installed or used without prior written approval from Architect shall be at risk of subsequent rejection.
 - a. Failure to complete required substitution request form or to submit requested information in acceptable format.
 - b. Where "No Substitutions" is noted or implied within individual Sections.
 - c. When substitutions are indicated or implied on Shop Drawings or Product Data submittals, without prior written approval from Architect.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN WORK

- A. Architect will issue supplemental instructions authorizing minor changes in Work, not involving adjustment to Contract Sum or Contract Time, on AIA Document G710 or similar form, or through web-based Project management software.

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in Work that may require adjustment to Contract Sum or 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 proposed change.
 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to Contract Sum and 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 effect of change, including changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect and Owner.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to Contract, Contractor may initiate a claim by submitting a request for a change to Architect.
1. Include a statement outlining reasons for change and effect of change on Work. Provide a complete description of proposed change. Indicate effect of proposed change on Contract Sum and 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 change.
 5. Include an updated Contractor's construction schedule that indicates effect of change, including changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of Contract Time.
 6. Comply with requirements in Section 012500 – Substitution Procedures if proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use form acceptable to Architect and Owner.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or similar form, or through web-based Project management software.

1.5 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in Work. It also designates method to be followed to determine change in Contract Sum or Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of Work required by Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 012900
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

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

1.3 SCHEDULE OF VALUES

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

1. Coordinate line items in schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit schedule of values to Architect and Owner at earliest possible date, but no later than 14 days after Notice to Proceed and prior to date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Separate Elements of Work: Where Contractor's construction schedule defines separate elements of Work, provide subschedules showing values coordinated with each element.

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

1. Identification: Include the following Project identification on schedule of values:
 - a. Project name and location.
 - b. Owner's name and project number.
 - c. Architect's name and Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of 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 1 percent of Contract Sum.
4. Provide a separate line item in schedule of values for each part of 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. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual Work-in-place as separate line items.
7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling 5 percent of Contract Sum and subcontract amount.
8. Schedule of Values Revisions: Revise schedule of values when Change Orders or Construction Change Directives result in a change in Contract Sum. Include at least 1 separate line item for each Change Order and Construction Change Directive.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following 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: Submit Application for Payment to Architect by date indicated in Agreement between Owner and Contractor. Periods covered by each Application for Payment is 1 month, ending on last day of month or as agreed to with Owner.
 - 1. Submit draft copy of Application for Payment 7 days prior to due date for review by Architect.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by Contractor shall be acceptable with written approval from Owner and Architect. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for Work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for Work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders 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.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit signed and notarized original copy of each Application for Payment to Architect digital information management system as specified in Section 013100, ensuring receipt within 24 hours. Include waivers of lien and similar attachments if required.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of Contract and related to Work covered by payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in Work must submit waivers.

4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of Work covered by application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. 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. Submittal schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from AHJ for performance of Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
- I. Application for Payment at Substantial Completion: After Architect issues Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portions of Work claimed as substantially complete.
1. Include documentation supporting claim that Work is substantially complete and a statement showing an accounting of changes to Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 – Closeout Procedures.
 2. Indicate in application Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of Work.
- J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of Work.
 10. Proof that taxes, fees, and similar obligations are paid.
 11. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative provisions for coordinating construction operations on Project including the following:
 - a. Informational submittals.
 - b. General coordination procedures.
 - c. Request for Interpretation (RFI).
 - d. Digital Project management procedures.
 - e. Architect's Digital Data Files.
 - f. Project meetings.

1.2 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Interpretation. Request from Owner, Architect, or Contractor seeking information required by or clarifications of Contract Documents.
- C. Digital Information Management System (DIMS): Architect's web-based digital information management software implemented for purposes of facilitating communications and managing documentation until Final Completion of Project.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate construction operations included in different Specification Sections to ensure efficient and orderly installation of each part of Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
2. Schedule construction operations in sequence required to obtain best results where installation of one part of Work depends on installation of other components, before or after its own installation.
3. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
4. Make adequate provisions to accommodate items scheduled for later installation.
5. 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.
 - a. Prepare similar memoranda for Owner and separate contractors if coordination of their work is required.

B. Coordination Digital Data Drawings: Prepare coordination digital data drawings according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Submittal Format: Submit or post coordination drawing files using Digital Information Management System.

3. BIM Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform 3-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.
 - b. Comply with digital data file requirements specified elsewhere in this Section for preparation of BIM files.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of Work. Such administrative activities include the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation meetings.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of 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 Sections covered by subcontract.
 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, 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.

1.5 REQUEST FOR INTERPRETATION (RFI)

- A. Immediately on discovery of need for additional information, clarification, or interpretation of Contract Documents, prepare and submit RFI on AIA Document G716 - Request for Information Form, or Contractor's own RFI Form if acceptable to Owner and Architect.
 1. Architect will return without response those RFIs submitted to Architect by entities other than Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Project Work.
 3. Whenever possible, request clarifications at next appropriate Project progress meeting, with response entered into meeting minutes to avoid issuing a formal RFI.
- B. Content of RFI: Include detailed, legible description of item needing information or interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Owner.
 5. Name of Contractor.
 6. Name of Architect.
 7. RFI number, numbered sequentially.

8. RFI subject.
 9. Specification Section number and title and related paragraphs, as appropriate.
 10. Drawing number and detail references, as appropriate.
 11. Field dimensions and conditions, as appropriate.
 12. Contractor's suggested resolution. If suggested resolution impacts Contract Time or Contract Sum, state impact in RFI.
 13. Contractor's signature.
 14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop 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. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 7 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 Contract Documents.
 - e. Requests for adjustments in Contract Time or 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 Contract Time or Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 – Contract Modification Procedures.
 - a. If Contractor believes RFI response warrants change in Contract Time or Contract Sum, notify Architect in writing within 10 days of receipt of RFI response.
- D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
 2. Name and address of Owner.
 3. Name and address of Contractor.
 4. Name and address of Architect.
 5. RFI number including RFIs that were returned without action or withdrawn.
 6. RFI description.
 7. Date the RFI was submitted.
 8. Date Architect's response was received.
 9. Identification of related Minor Change in Work, Construction Change Directive, and Proposal Request, as appropriate.
- E. On receipt of Architect's action, update RFI log and immediately distribute RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.
- 1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES
- A. Web-Based Digital Information Management System: Architect uses a web-based Digital Information Management System for purposes of hosting and managing Project communication and documentation until Final Completion. Use of this System for transmitting Project documentation is mandatory unless another option is approved by Architect.
1. Digital Information Management System performs the following minimum functions:
 - a. Receives, logs, and stores Project Documents.
 - b. Provides electronic stamping and signatures.

- c. Notifies addressees via email.
 2. Web-Based Digital Information Management Service: Newforma Project Center.
 3. Digital Information Management System shall include the following:
 - a. Project directory.
 - b. Project correspondence.
 - c. Drawing and Specification document hosting, viewing, and updating.
 - d. Meeting minutes.
 - e. Contract modification forms and logs.
 - f. RFI forms and logs.
 - g. Submittal forms and logs.
 - h. Architect's Supplementary Instruction forms and logs.
 - i. Proposal request forms and logs.
 - j. Change Order forms and logs.
 - k. Reminder and tracking functions.
 - l. Task and issue management.
 - m. Photo documentation.
 - n. Schedule and calendar management.
 - o. Payment application forms.
 - p. Online document collaboration.
 - q. Archiving function.
 - B. Conditions for Use of Digital Information Management System:
 1. Use Digital Information Management System for Project communications and submittals containing electronic files.
 2. Access: Valid email address, internet service, and PDF software are required of each party.
 3. Contractor's failure to submit and retrieve through Digital Information Management System will not be considered in delay claims associated with lost or missing information.
 4. Architect assumes no responsibility for information lost or not received by Contractor's failure to submit through Digital Information Management System.
 5. Contractor's failure to submit and retrieve through Digital Information Management System will not be considered in delay claims associated with lost or missing information.
 6. Architect assumes no responsibility for information lost or not received by Contractor's failure to submit through Digital Information Management System.
 - C. Project Execution Plan:
 1. Refer to Project Execution Plan for information regarding use of digital data files, including:
 - a. BIM execution.
 - b. Project goals,
 - c. Modeling.
 - d. Collaboration.
 - e. Deliverables.
 - D. Training: Arrange for and conduct 1 hour web-based training session for Architect or Architect's representative, Contractor, and other necessary entities in use of Digital Information Management System software.
- 1.7 ARCHITECT'S DIGITAL DATA FILES
 - A. Architect's digital data files of BIM model and CAD drawings will be available for use in preparing Shop Drawings, Coordination drawings, Project record drawings, and other digital drawings required in these Specifications.
 1. Architect will grant access to Architect's digital data files to Contractor, Contractor's key personnel, Subcontractors, and other parties as necessary, at initial preconstruction meeting.
 2. Refer to Electronic Media Transfer Disclaimer for requirements pertaining to use of Architect's digital data files.

- B. Digital Data Licensing Agreement:
 - 1. Prior to Architect releasing digital data files, parties receiving Architect's digital data files shall execute licensing agreement as administered through Newforma Info Exchange or Project Center.
 - a. AIA Document C106 Digital Data Licensing Agreement is an acceptable form of digital data licensing agreement.

1.8 PROJECT MEETINGS

- A. Schedule and conduct meetings 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.
 - 2. Notify Owner and Architect of scheduled meeting dates and times a minimum of 15 working days prior to meeting, unless indicated otherwise.
 - 3. Agenda: Prepare meeting agenda. Distribute agenda to invited attendees.
 - 4. Minutes: Each party responsible for conducting meetings shall record significant discussions, agreements, disagreements, and corrective measures and actions.
 - a. Distribute meeting minutes to everyone concerned, including Owner and Architect, within 3 days of meeting.
- B. Preconstruction Meeting: Schedule and conduct a preconstruction meeting before starting construction at a time convenient to Owner and Architect, but no later than 14 days after Notice of Award.
 - 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. Participants at meeting shall be familiar with Project and authorized to conclude matters relating to Work.
 - 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Critical Work sequencing and long lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Use of web-based Digital Information Management software.
 - g. Procedures for processing field decisions and Change Orders.
 - h. Procedures for RFIs.
 - i. Procedures for testing and inspecting.
 - j. Procedures for processing Applications for Payment.
 - k. Distribution of Contract Documents.
 - l. Submittal procedures.
 - m. Preparation of Record Documents.
 - n. Use of the premises and existing building.
 - o. Work restrictions.
 - p. Working hours.
 - q. Owner's occupancy requirements.
 - r. Responsibility for temporary facilities and controls.
 - s. Procedures for moisture and mold control.
 - t. Procedures for disruptions and shutdowns.
 - u. Construction waste management and recycling.
 - v. Parking availability.
 - w. Office, Work, and storage areas.
 - x. Equipment deliveries and priorities.
 - y. First aid.
 - z. Security.
 - aa. Progress cleaning.

3. Minutes: Record and distribute meeting minutes.
- C. Preinstallation Meetings: Schedule and conduct preinstallation meetings 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 installation and its coordination or integration with other materials and installations that have preceded or will follow. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for 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. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other Work.
 - w. Required performance results.
 - x. Protection of adjacent Work.
 - y. Protection of construction and personnel.
 3. Do not proceed with installation if meeting cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene meeting at earliest feasible date.
 4. Minutes: Record and distribute meeting minutes.
- D. Preinstallation Walkthrough: Prior to installation, Schedule and conduct preinstallation walkthrough in each unit type to determine locations for electrical light switches, outlet boxes, low-voltage boxes, and thermostat boxes.
1. Attendees: Owner, Architect, Contractor, electrical Subcontractor, Project Superintendent, and other entities affecting this Work.
 2. Notify Owner and Architect of scheduled meeting dates and times a minimum of 7 working days prior to meeting.
 3. Agenda:
 - a. Confirmation of box locations according to Contract Documents and as required Building Code Accessibility requirements.
 - b. Identification of problems that impede, or may impede, future work, such as installation of casework and appliances.

- c. Document acceptance of initial box locations and how non-acceptable Work will be corrected, including agreed upon alternative solutions. Balance of Work within units will be based on agreed upon locations.
 4. Do not proceed with electrical Work until this walk through has occurred and parties agree.
 5. Minutes: Record and distribute meeting minutes.
 - a. Include copies of document indicating agreed upon locations of electrical switches and boxes.
- E. Progress Meetings: Schedule and conduct progress meetings at a maximum of weekly intervals.
 1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: Owner, Owner's Commissioning Authority, Architect, Contractor, superintendent, Subcontractors, suppliers, Installers, relevant consultants, and other entities concerned with current progress or involved in planning, coordination, or performance of future activities. Participants at meeting shall be familiar with Project and authorized to conclude matters relating to 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 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 Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and Work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
 4. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 5. Minutes: Record and distribute meeting minutes.
- F. Project Closeout Meeting: Schedule and conduct Project closeout meeting at a time convenient to Owner and Architect, but no later than 30 days prior to scheduled date of Substantial Completion.
 1. Conduct meeting 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. Participants at meeting shall be familiar with Project and authorized to conclude matters relating to Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. **[Requirements for completing sustainable design documentation.**
 - f.]Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 4. Minutes: Record and distribute meeting minutes.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013200
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for documenting progress of construction during performance of Work, including the following:
 - a. Startup construction schedule.
 - b. Contractor's Construction Schedule.
 - c. Construction schedule updating reports.
 - d. Daily construction reports.
 - e. Material location reports.
 - f. Site condition reports.
 - g. Unusual event reports.

1.2 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 planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in network.
 3. Successor Activity: An activity that follows another activity in network.
- B. Cost Loading: Allocation of schedule of values for completing an activity as scheduled. The sum of costs for activities shall equal total Contract Sum.
- C. Critical Path: Longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: Starting or ending point of an activity.
- E. Float: Measure of leeway in starting and completing an activity.
1. Float Time: Ownership and benefit of float time is described in Owner-Contractor agreement.
 2. Free Float: Amount of time an activity can be delayed without adversely affecting early start of successor activity.
 3. Total Float: Measure of leeway in starting or completing an activity without adversely affecting planned Project completion date.
- F. Resource Loading: Allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in compliance with Section 013100 – Project Management and Coordination for Digital Information Management Systems.
1. Working electronic copy of schedule file, where indicated.
- B. Startup Construction Schedule.
1. 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 weekly intervals.
- F. Material Location Reports: Submit at weekly intervals.
- G. Site Condition Reports: Submit at time of discovery of differing conditions.
- H. Unusual Event Reports: Submit at time of unusual event.

1.4 QUALITY ASSURANCE

- A. Prescheduling Meeting: Conduct meeting at Project site after Notice of Award to comply with requirements in Section 013100 – Project Management and Coordination.
 - 1. Review methods and procedures related to preliminary construction schedule and Contractor's Construction Schedule, including the following:
 - 2. Review software limitations and content and format for reports.
 - 3. Verify availability of qualified personnel needed to develop and update schedule.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.5 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, for current Windows operating system.
- B. Time Frame: Extend schedule from date established for Notice of Award to date of Substantial 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 Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 15 days, unless specifically allowed by Architect.
 - 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include 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 Contract Documents and as follows in schedule, and show how sequence of Work is affected.
1. Include delivery dates for Owner-furnished products and products ordered in advance. Delivery dates indicated stipulate earliest possible delivery dates.
 2. Products Ordered in Advance: Include a separate activity for each product.
 3. Owner-Furnished Products: Include a separate activity for each product.
 4. Work Restrictions: Show the effect of the following items on schedule:
 - a. Partial occupancy before Substantial Completion.
 - b. Use-of-premises restrictions.
 - c. Provisions for future construction.
 - d. Seasonal variations.
 - e. Environmental control.
 5. Work Stages: Indicate important stages of construction for each major portion of Work, including the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
- E. Construction Areas: Identify each major area of construction for each major portion of Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
1. Structural completion.
 2. Temporary enclosure and space conditioning.
 3. Permanent space enclosure.
 4. Completion of mechanical installation.
 5. Completion of electrical installation.
 6. Substantial Completion.
- F. Milestones: Include milestones indicated in Contract Documents in schedule, including Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
1. Temporary enclosure and space conditioning.
- G. 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 Work and Contract Time.
- H. Contractor's Construction Schedule Updating: At weekly Owner-Architect-Contractor meetings, update schedule to reflect actual construction progress and activities. Issue schedule 1 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 report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including changes in logic, durations, actual starts and finishes, and activity durations.
 3. As Work progresses, indicate final completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates Work is 14 or more calendar days behind current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect Owner, 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 same parties and post in same locations. Delete parties from distribution when they have completed their assigned portion of Work and are no longer involved in performance of construction activities.

1.6 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. Approximate count of personnel at Project site.
 3. Equipment at Project site.
 4. Material deliveries.
 5. High and low temperatures and general weather conditions, including presence of rain or snow.
 6. Testing and inspection.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events.
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site . List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of differing conditions, together with recommendations for changing Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to 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 1 days of an occurrence. Distribute copies of report to parties affected by occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

SECTION 013233
PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Administrative and procedural requirements for the following:
 - a. Preconstruction photographs.
 - b. Concealed Work photographs.
 - c. Periodic construction photographs.
 - d. Final completion construction photographs.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within 3 days of taking photographs.
 - 1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image in web-based project software site:
 - a. Name of Project.
 - b. Name of Architect.
 - c. Name of Contractor.
 - d. Date photograph was taken.
 - e. Description of location, vantage point, and direction.
 - f. Unique sequential identifier keyed to accompanying key plan.

1.3 CONSTRUCTION PHOTOGRAPHS

- A. Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take photographs to show existing conditions adjacent to property before starting Work.
 - 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at the start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing Work that will conceal other Work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.

4. Electrical conduit.
 5. Waterproofing and weather-resistant barriers.
- D. Periodic Construction Photographs: Take weekly coinciding with cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.
- F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified.
1. 3 days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

SECTION 013300
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for submittals.
 - 2. Submittal schedule requirements.

1.2 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. Digital Information Management System (DIMS): Defined in Section 013100 – Project Management and Coordination.
- C. 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."

1.3 SUBMITTAL SCHEDULE

- A. Prepare and submit each type of submittal required by individual Specification Sections.
 - 1. Comply with requirements of Section 013100 – Project Management and Coordination for submittals using Digital Information Management System.
 - 2. Prepare submittals in PDF format and upload to Digital Information Management System. Enter required data in Digital Information Management System to fully identify submittal.
 - a. Paper document transmittals and emailed PDF documents will not be reviewed.
 - 3. Architect will return annotated file. Annotate and retain 1 copy of file as an electronic Project record document file.
 - 4. Commissioning Authority, through Architect, will return annotated file.
- B. 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 submittal items required for each Specification Section concurrently unless partial submittals for portions of Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of 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 Contract Time will be authorized because of failure to transmit submittals enough in advance of Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 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 15 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 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
 - a. Submit 1 copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- 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.

1.4 ACTION SUBMITTALS

- 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, schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during first 60 days of construction. List those submittals required to maintain orderly progress of Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with 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 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. Unique submittal number, including revision identifier. 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. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. 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 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. Submittals for Digital Information Management System: Prepare PDF submittals as indicated in Section 013100.

1.6 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. Manufacturer's written recommendations.
 - d. Manufacturer's installation instructions.
 - e. Standard color charts.
 - f. Statement of compliance with specified referenced standards.
 - g. Testing by recognized testing agency.
 - h. Application of testing agency labels and seals.
 - i. Notation of coordination requirements.
 - j. 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 Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in Contract Documents. Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Schedules.
 - d. Compliance with specified standards.
 - e. Notation of coordination requirements.
 - f. Notation of dimensions established by field measurement.
 - g. Relationship and attachment to adjoining construction clearly indicated.
 - h. Seal and signature of professional engineer if specified.
 2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.
 - a. Prepare BIM files in compliance with digital data file requirements specified in Section 013100 – Project Management and Coordination.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 1) Web-Based Digital Information Management Software: Prepare submittals in PDF form, and upload to web-based Digital Information Management System. Enter required data in Digital Information Management System to fully identify submittal.
 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout 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 Work are indicated in individual Specification Sections. Ensure Samples are in undamaged condition at time of use.
 - b. Samples not incorporated into Work, or otherwise designated as Owner's property, are property of Contractor.
 4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
 5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for 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 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 3 sets of Samples. Architect will retain 2 Sample sets; remainder will be returned. Mark up and retain 1 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 3 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 Work and their intended location. Include the following information in tabular form:
 1. Type of product. Include unique identifier for each product indicated in 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.
 - a. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - b. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in 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 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 Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in Contract Documents.
 - a. 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 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 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 Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in 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.
- I. Material Safety Data Sheets (MSDSs): Submit information directly to Owner.
1. Do not submit MSDSs to Architect. Architect will not review submittals that include MSDSs and will return entire submittal.
- 1.7 DELEGATED-DESIGN SERVICES
- A. Refer to Section 013573 – Delegated-Design Procedures for delegated-design submittal information.
- 1.8 CONTRACTOR'S REVIEW
- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of Contract and for compliance with Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract Documents.
1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.
- 1.9 ARCHITECT'S REVIEW
- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it to Contractor as follows:
1. PDF Submittals: Architect will indicate, via markup stamped on each submittal, appropriate action, as follows:
 - a. Reviewed.
 - b. Rejected.
 - c. Submit Specific Item.
 - d. Furnish as Corrected.
 - e. Revise and Resubmit.

2. Web-Based Project Management Software Submittals: Architect will indicate, on Project management software website, appropriate action based on web-based action options.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements.
 1. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will return without review or discard submittals received from sources other than Contractor.
- F. Submittals not required by Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

SECTION 014000
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. 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 Contract Document requirements.
 - 1. Owner will engage testing and inspection services unless indicated otherwise.
 - 2. 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.
 - 3. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with Contract Document requirements.
 - 4. 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.
 - 5. Specific test and inspection requirements are specified in other Specification Sections.
- C. Related Requirements:
 - 1. Section 014339 – Mockups.

1.2 DEFINITIONS

- A.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of 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 Work result does not require that certain construction activities specified apply exclusively to specific trades.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than Project do not meet this definition.
- E. 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.
- F. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

- G. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of Work to evaluate that actual products incorporated into Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.
- H. Source Quality-Control Tests: Tests and inspections that are performed at source; for example, plant, mill, factory, or shop.
- I. Testing Agency: Independent entity engaged to perform specific inspections, tests, or both, either at Project site or elsewhere, or to report on and, if required, to interpret results of those inspections or tests.

1.3 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with 2 or more standards or requirements are specified and standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with most stringent requirement.
 - 1. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: Quantity or quality level shown or specified shall be minimum provided or performed.
 - 1. Actual installation may comply exactly with minimum quantity or quality specified, or it may exceed minimum within reasonable limits.
 - 2. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for context of requirements.
 - 3. Refer uncertainties to Architect for a decision before proceeding.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. 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.
 - a. Schedule times for tests, inspections, obtaining samples, and similar activities.
- B. Scheduling: Prepare schedule of tests, inspections, and similar quality-control services required by Contract Documents as a component of Contractor's quality-control plan
 - 1. Coordinate and submit concurrently with Contractor's Construction Schedule.
 - 2. Update as Work progresses.
 - 3. Distribute schedules to Owner, Architect, testing agencies, and each party involved in performance of portions of Work where tests and inspections are required.

1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings: Comply with requirements in Section 014339 – Mockups.

1.6 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 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 Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan: Submit quality-control plan within 10 days of Notice of Award, and not less than 5 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 shall not have other Project responsibilities.
- 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 Statement of Special Inspections.
 3. Owner-performed tests and inspections indicated in 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.

1.8 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 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 Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.

1.9 QUALITY ASSURANCE

- A. Qualifications paragraphs in this Article establish 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 kind indicated.
 1. Engineering services are defined as those performed for installations of systems, assemblies, or products that are similar in material, design, and extent to those indicated for this Project.
- F. Delegated-Design Engineer's Qualifications: Specified in Section 013573 – Delegated-Design Procedures.
- G. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for activities indicated.
 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

- H. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- I. 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.
- J. 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.
- K. 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:
 - 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 Work.
 - c. Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens and test assemblies. Do not reuse products on Project.
 - f. Build laboratory mockups to comply with Section 014335 – Mockups.
 - 2. Testing Agency Responsibilities:
 - a. Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor.
 - b. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from Contract Documents.
- L. Mockups: Comply with requirements in Section 014335 – Mockups.

1.10 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 reinspecting construction that replaces or is necessitated by Work that failed to comply with Contract Documents will be charged to Contractor, and Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that 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 Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with 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 Work during performance of its services.
 2. Determine 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 Contract Document requirements or approve or accept any portion of 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 Work. Manufacturer's technical representative's services include participation in preinstallation meetings, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of Work, and submittal of written reports.
- G. Contractor's Associated Requirements and 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 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.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections on structural Drawings, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing completeness and adequacy of those procedures to perform Work.
 2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in 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, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from Contract Documents.
 6. Retesting and reinspecting corrected Work.
- B. 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, indicated in Statement of Special Inspections on structural Drawings, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing completeness and adequacy of those procedures to perform 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, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from Contract Documents.
 6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of 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.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR

- A. On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

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

3.3 FIELD QUALITY CONTROL

A. Manufacturer Services:

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

3.4 PROTECTION

- A. Protect construction exposed by or for quality-control service activities.
- B. Repair and protection are Contractor's responsibility, regardless of assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200

REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Basic Contract definitions are included in Conditions of the Contract. Other definitions are included in individual Specification Documents and Sections.
- B. Addenda: Written and/or graphic instruments issued by Architect prior to execution of Contract that modify or interpret Bidding Documents by additions, deletions, clarifications, or corrections. Addenda become part of Contract Documents when Construction Contract is executed.
- C. 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.
- D. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- E. By Owner (BO): Items that will be ordered, paid for, and shipped to Project by Owner. Contractor shall receive, unload, unpack or uncrate, protect, move into place, install, and connect these items as specified or indicated in Contract Documents.
- F. Directed: A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- G. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of 5 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.
- H. Furnish: Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- I. Herein: Contents of a particular Specification Section, or contents within any or all of parts and sections of Conditions of the Contract (General and Supplementary Conditions) and Division 01 - General Requirements.
- J. 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."
- K. Install: Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- L. Installer/Erector/Applicator: Contractor or another entity engaged by Contractor, either as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Installers shall be experienced in operations in which they are engaged to perform.
 - 2. 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).
- M. (NIC) Not in Contract. Products not in Contract, but which may require provisions in construction for future installation by others.

- N. OFOI: Owner furnished – Owner installed.
- O. OFCI: Owner furnished – Contractor installed.
- P. Product: Material, machinery, components, equipment, fixtures, and systems forming Work result. Not materials or equipment used for preparation, fabrication, conveying, or erection, and not incorporated into Work result. Products may be new, never before used, or re-used materials or equipment.
- Q. Project Manual: A volume assembled for the Work that may include Bidding requirements, sample forms, Conditions of the Contract, and Specifications.
- R. Project Site: Space available for performing construction activities. Extent of Project site is shown on Drawings and may or may not be identical with description of land on which Project is to be built.
- S. Provide: Furnish and install, complete and ready for intended use.
- T. 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.
- U. Trades: Using terms such as carpentry is not intended to imply that accredited or unionized individuals of corresponding generic name, such as carpenter, must perform certain construction activities. It also does not imply that requirements specified apply exclusively to tradespeople of corresponding generic name.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents to extent referenced.
 - 1. Such standards are made a part of Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 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 entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of entities in the following list. This information is subject to change and is believed to be accurate as of date of Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 4. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 5. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.

6. ABMA - American Boiler Manufacturers Association; www.abma.com.
7. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
8. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
9. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
10. AF&PA - American Forest & Paper Association; www.afandpa.org.
11. AGA - American Gas Association; www.aga.org.
12. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
14. AI - Asphalt Institute; www.asphaltinstitute.org.
15. AIA - American Institute of Architects (The); www.aia.org.
16. AISC - American Institute of Steel Construction; www.aisc.org.
17. AISI - American Iron and Steel Institute; www.steel.org.
18. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
19. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
20. ANSI - American National Standards Institute; www.ansi.org.
21. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
22. APA - The Engineered Wood Association; www.apawood.org.
23. APA - Architectural Precast Association; www.archprecast.org.
24. API - American Petroleum Institute; www.api.org.
25. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
26. ARI - American Refrigeration Institute; (See AHRI).
27. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
28. ASCE - American Society of Civil Engineers; www.asce.org.
29. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
30. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
31. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
32. ASSE - American Society of Safety Engineers (The); www.asse.org.
33. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
34. ASTM - ASTM International; www.astm.org.
35. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
36. AWI - Architectural Woodwork Institute; www.awinet.org.
37. AWMAC – Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
38. AWPA - American Wood Protection Association; www.awpa.com.
39. AWS - American Welding Society; www.aws.org.
40. AWWA - American Water Works Association; www.awwa.org.
41. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
42. BIA - Brick Industry Association (The); www.gobrick.com.
43. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
44. CDA - Copper Development Association; www.copper.org.
45. CEA - Consumer Electronics Association; www.ce.org.
46. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
47. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
48. CGA - Compressed Gas Association; www.cganet.com.
49. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
50. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
51. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
52. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
53. CPA - Composite Panel Association; www.pbmdf.com.
54. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
55. CRRC - Cool Roof Rating Council; www.coolroofs.org.
56. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
57. CSA - CSA Group; www.csa.ca.

58. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
59. CSI - Construction Specifications Institute (The); www.csinet.org.
60. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
61. CWC - Composite Wood Council; (See CPA).
62. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
63. DHI - Door and Hardware Institute; www.dhi.org.
64. ECA - Electronic Components Association; (See ECIA).
65. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
66. ECIA - Electronic Components Industry Association; www.eciaonline.org.
67. EIA - Electronic Industries Alliance; (See TIA).
68. EIMA - EIFS Industry Members Association; www.eima.com.
69. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
70. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
71. ETL - Intertek (See Intertek); www.intertek.com.
72. EVO - Efficiency Valuation Organization; www.evo-world.org.
73. FCI - Fluid Controls Institute; www.fluidcontrolsintitute.org.
74. FM Approvals - FM Approvals LLC; www.fmglobal.com.
75. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
76. FSA - Fluid Sealing Association; www.fluidsealing.com.
77. FSC - Forest Stewardship Council U.S.; www.fscus.org.
78. GA - Gypsum Association; www.gypsum.org.
79. GANA - Glass Association of North America; www.glasswebsite.com.
80. GS - Green Seal; www.greenseal.org.
81. HI - Hydraulic Institute; www.pumps.org.
82. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
83. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
84. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
85. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
86. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
87. IAS - International Accreditation Service; www.iasonline.org.
88. IAS - International Approval Services; (See CSA).
89. ICBO - International Conference of Building Officials; (See ICC).
90. ICC - International Code Council; www.iccsafe.org.
91. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
92. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
93. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
94. IEC - International Electrotechnical Commission; www.iec.ch.
95. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
96. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
97. IESNA - Illuminating Engineering Society of North America; (See IES).
98. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
99. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
100. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
101. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
102. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
103. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
104. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
105. ISO - International Organization for Standardization; www.iso.org.
106. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
107. ITU - International Telecommunication Union; www.itu.int/home.

108. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
109. LMA - Laminating Materials Association; (See CPA).
110. LPI - Lightning Protection Institute; www.lightning.org.
111. MBMA - Metal Building Manufacturers Association; www.mbma.com.
112. MCA - Metal Construction Association; www.metalconstruction.org.
113. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
114. MHIA - Material Handling Industry of America; www.mhia.org.
115. MIA - Marble Institute of America; www.marble-institute.com.
116. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
117. MPI - Master Painters Institute; www.paintinfo.com.
118. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
119. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
120. NAAWS - North American Architectural Woodwork Standards; <https://www.naaws-committee.com>.
121. NADCA - National Air Duct Cleaners Association; www.nadca.com.
122. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
123. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
124. NBI - New Buildings Institute; www.newbuildings.org.
125. NCMA - National Concrete Masonry Association; www.ncma.org.
126. NEBB - National Environmental Balancing Bureau; www.nebb.org.
127. NECA - National Electrical Contractors Association; www.necanet.org.
128. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
129. NEMA - National Electrical Manufacturers Association; www.nema.org.
130. NETA - InterNational Electrical Testing Association; www.netaworld.org.
131. NFPA - National Fire Protection Association; www.nfpa.org.
132. NFPA - NFPA International; (See NFPA).
133. NFRC - National Fenestration Rating Council; www.nfrc.org.
134. NHLA - National Hardwood Lumber Association; www.nhla.com.
135. NLGA - National Lumber Grades Authority; www.nlga.org.
136. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
137. NRCA - National Roofing Contractors Association; www.nrca.net.
138. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
139. NSF - NSF International; www.nsf.org.
140. NSPE - National Society of Professional Engineers; www.nspe.org.
141. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
142. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
143. NWFA - National Wood Flooring Association; www.nwfa.org.
144. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
145. PDI - Plumbing & Drainage Institute; www.pdionline.org.
146. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
147. RFCI - Resilient Floor Covering Institute; www.rfci.com.
148. SAE - SAE International; www.sae.org.
149. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
150. SDI - Steel Deck Institute; www.sdi.org.
151. SDI - Steel Door Institute; www.steeldoors.org.
152. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
153. SIA - Security Industry Association; www.siaonline.org.
154. SJI - Steel Joist Institute; www.steeljoist.org.
155. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
156. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
157. SPIB - Southern Pine Inspection Bureau; www.spib.org.
158. SPRI - Single Ply Roofing Industry; www.spri.org.
159. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.

160. SSINA - Specialty Steel Industry of North America; www.ssina.com.
 161. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
 162. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
 163. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
 164. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 165. TIA - Telecommunications Industry Association; (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
 166. TMS - The Masonry Society; www.masonrysociety.org.
 167. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
 168. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
 169. USGBC - U.S. Green Building Council; www.usgbc.org.
 170. WA - Wallcoverings Association; www.wallcoverings.org.
 171. WASTEC - Waste Equipment Technology Association; www.wastec.org.
 172. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
 173. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 174. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 175. WI - Woodwork Institute; www.wicnet.org.
 176. WWPA - Western Wood Products Association; www.wwpa.org.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of entities in the following list. This information is believed to be accurate as of the date of Contract Documents.
1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 2. ICC - International Code Council; www.iccsafe.org.
 3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean recognized name of entities in the following list. Information is subject to change and is up to date as of the date of Contract Documents.
1. CPSC; Consumer Product Safety Commission; www.cpsc.gov.
 2. DOC; Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 3. DOE; Department of Energy; www.energy.gov.
 4. EPA; Environmental Protection Agency; www.epa.gov.
 5. FG; Federal Government Publications; www.gpo.gov/fdsys.
 6. GSA; General Services Administration; www.gsa.gov.
 7. LBL; Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 8. OSHA; Occupational Safety & Health Administration; www.osha.gov.
 9. SD; Department of State; www.state.gov.
 10. TRB; Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 11. USDA; Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 12. USPS; United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of Contract Documents.
1. CFR; Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. FED-STD; Federal Standard; (See FS).
 3. FS; Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 4. Available from General Services Administration; www.gsa.gov.

5. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. USAB; United States Access Board; www.access-board.gov.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. 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.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into Work, whether purchased for Project or taken from previously purchased stock.

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 \ Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility.
 - a. Salvaged items or items reused from other projects are not considered new products.
 - b. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through comparable product submittal process described in Part 2 Comparable Products Article, to have indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
4. Includes terms "material," "equipment," "system," and terms of similar intent.

B. Basis-of-Design Product Specification: A Specification Section 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.

1. Published attributes and characteristics of basis-of-design products establish salient characteristics of products.
2. Evaluation of Comparable Products: In addition to basis-of-design product description, product attributes and characteristics may be listed to establish 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 Specifications.
3. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where "Subject to compliance with requirements" introduces a product selection procedure in individual Specification Sections, provide products qualified under specified product procedure.

1. In the event a named product or product by named manufacturer does not meet other requirements of Specifications, select another named product or product from another named manufacturer that does meet requirements of Specifications.
2. If applicable, submit a Substitution Request Form in compliance with Substitution Requests requirements in Section 012500 – Substitution Procedures.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product as an "approved substitution," including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section Number and Title and Drawing numbers and titles.
2. Data indicating compliance with requirements specified in Part 2 "Comparable Products" Article.
3. Submit a Substitution Request Form in compliance with Substitution Requests requirements in Section 012500 – Substitution Procedures.

- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 – Submittal Procedures indicating compliance with requirements.
- F. Substitution: Refer to Section 012500 – Substitution Procedures for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between 2 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 exterior.
1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.5 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 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 Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare 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 Specifications, prepare 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 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 Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
 6. Approved Substitution: For products specified by name, and accompanied by "approved substitution," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by Architect; whose determination is final.
 - b. The terms "or equal" or "or approved equal" are not used in these Specifications.
- B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide named product that complies with requirements.
 - 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 named manufacturer or source that complies with requirements.
 - 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 1 of the products listed that complies with requirements.
 - a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following:"
 4. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by 1 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:"
 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide 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 product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by 1 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.
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.
 2. Architect's decision will be final on whether a proposed product matches.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a 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.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements.
1. Comply with Division 01 Section for Sustainability Design Requirements and individual Specification Sections.
 2. Select products for which sustainable design documentation submittals are available from manufacturer.
- ## 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 Contract Documents, is consistent with Contract Documents, will produce indicated results, and is compatible with other portions of Work.

2. Detailed comparison of significant qualities of proposed product with those named in 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.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
- B. Architect's Action on Substitution Requests: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 – Submittal Procedures.
1. Substitution Request Forms: As specified in Section 013300 – Submittal Procedures.
 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements.
1. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300

EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of Work including the following:
 - 1. Construction layout.
 - 2. Installation of Work.
 - 3. Cutting and patching.
 - 4. Progress cleaning.
 - 5. Starting and adjusting.
 - 6. Protection of installed construction.

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 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate construction and operations of Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of Work.
 - a. Adjust construction schedule based on a mutually agreeable timetable.
 - b. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Meetings: Include Owner's construction personnel at preinstallation meetings covering portions of Work that are to receive Owner's work.
 - a. Attend preinstallation meetings conducted by Owner's construction personnel if portions of Work depend on Owner's construction.
- B. Cutting and Patching Meeting: Conduct meeting at Project site.
 - 1. Prior to commencing Work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching Work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's Superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities Subcontractors' supervisors, to extent each trade is affecting by cutting and patching operations.
 - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.

- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to 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.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit 2 copies signed by land surveyor.
- E. Final Property Survey: Submit 10 copies showing 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, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.

- j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce 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 products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to 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 visual and functional performance of in-place materials.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with California Code of Regulations maximum allowable VOC levels.

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 existence and location of underground utilities and other construction affecting Work.
 - 1. Before construction, verify location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for

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

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

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction.
1. Coordinate with AHJ.
- B. Field Measurements: Take field measurements as required to fit Work properly.
1. Recheck measurements before installing each product. Where portions of Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication.
 2. Coordinate fabrication schedule with construction progress to avoid delaying 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 Contract Documents caused by differing field conditions outside control of Contractor, submit a request for information to Architect according to requirements in Section 013100 – Project Management and Coordination.

3.3 CONSTRUCTION LAYOUT

- A. Before proceeding to lay out Work, verify layout information shown on Drawings in relation to property survey and existing benchmarks.
1. If discrepancies are discovered, promptly notify Architect.
- B. Record Log:
1. Maintain a log of layout control Work.
 2. 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.
 3. Make log available for reference by Architect.

3.4 INSTALLATION

- A. Locate Work and components of Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical Work plumb and make horizontal Work level.

2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at time and under conditions that will ensure best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of 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 Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 – Closeout Procedures for repairing or removing and replacing defective Work.
- 3.5 CUTTING AND PATCHING
- A. Cutting and Patching: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011100 – Summary of Work.
- 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] [prevent] interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed, extend 1 finished area into another, patch and repair floor and wall surfaces in 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 patch, and apply final paint coat over entire unbroken surface containing patch . Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

- A. Clean Project site and Work areas daily, including common areas. Enforce requirements strictly. Lawfully dispose of materials.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than 7 days during normal weather or 3 days if temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- 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 Work.
 - 1. Promptly remove liquid spills.
 - 2. Where dust would impair proper execution of Work, broom-clean or vacuum 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 space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 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 remainder of 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 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 Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for contract closeout, including the following:
 - a. Substantial Completion procedures.
 - b. Final completion procedures.
 - c. Warranties.
 - d. Final cleaning, including final cleaning of HVAC Work.
 - e. Repair of Work.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for Architect's use prior to Architect's inspection, to determine if Work is substantially complete.

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.
- 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 value of each item on list and reasons why 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 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, 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 Architect's 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.
 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 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 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 reinspection when Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form basis of requirements for final completion.
- E. Certificate of Substantial Completion. Architect will date and sign certification of Substantial Completion on AIA Document G704–2017 “Certificate of Substantial Completion,” for date Work, or a portion of Work, is sufficiently complete and may be occupied for intended use
- 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 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 final completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance no less than 10 days prior to date Work will be completed and ready for final inspection and tests.
1. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements.
 2. 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.
 3. Request reinspection when 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 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 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 PDF electronic file in compliance with Digital Information Management System requirements in Section 013100 – Project Management and Coordination. Architect will return annotated file.
- 1.9 SUBMITTAL OF PROJECT WARRANTIES
- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of 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 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 table of contents of the Specifications.
- 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 in compliance with Digital Information Management System requirements in Section 013100 – Project Management and Coordination.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. 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.
 - 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.

- 1) Clean HVAC system in compliance with Division 23 Section for Existing HVAC Air-Distribution System Cleaning. Provide written report on completion of cleaning.
 - p. Clean luminaires, 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.
1. Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 – Construction Waste Management and Disposal.
- 3.2 REPAIR
- 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

SECTION 017823
OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - a. Operation and maintenance documentation directory manuals.
 - b. Emergency manuals.
 - c. Systems and equipment operation manuals.
 - d. Systems and equipment maintenance manuals.
 - e. Product maintenance manuals.

1.2 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.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate and assemble operation and maintenance documentation from each factory-authorized service representative where installations include multiple manufacturer representatives.

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 time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in accordance with Digital Information Management System requirements as specified in Section 013100 – Project Management and Coordination.
 1. PDF Electronic File. Assemble each manual into composite electronically indexed file.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 – Closeout Procedures for schedule for submitting operation and maintenance documentation.
- 1.5 **FORMAT OF OPERATION AND MAINTENANCE MANUALS**
- A. **Manuals, Electronic Files:** Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. **Electronic Files:** Use electronic files prepared by manufacturer where available.
 - a. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. **File Names and Bookmarks:** Bookmark individual documents based on file names.
 - a. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents.
 - b. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect system, subsystem, and equipment names in a readily navigated file tree.
 - c. Configure electronic manual to display bookmark panel on opening file.
- 1.6 **REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**
- A. **Organization of Manuals:** Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. **Title Page:** Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Architect.
 7. Name and contact information for Commissioning Authority.
 8. Names and contact information for major consultants to Architect that designed systems contained in manuals.
 9. Cross-reference to related systems in other operation and maintenance manuals.
- C. **Table of Contents:** List each product included in manual, identified by product name, indexed to content of volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than 1 volume to accommodate data, include comprehensive table of contents for each volume of set.
- D. **Manual Contents:** Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment.
1. If possible, assemble instructions for subsystems, equipment, and components of 1 system into a single binder.
- E. **Identification:** In documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in Contract Documents.

1. If no designation exists, assign designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 1. Fire.
 2. Flood.
 3. Gas leak.
 4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.
 4. Required sequences for electric or electronic systems.
 5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in 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 sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.
- 1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS
- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and Drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into Work. If data include more than 1 item in a tabular format, identify each item using appropriate references from Contract Documents. Identify data applicable to Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into 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 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 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.

1.2 CLOSEOUT SUBMITTALS

- A. Where digital file submittals are indicated, prepare record document files in compliance with digital data file requirements specified in Section 013100 – Project Management and Coordination. Submit record documents in the following format unless indicated otherwise:
 - 1. Record Drawings, Specifications, and Product Data: Annotated PDF electronic files of types of Document required unless indicated otherwise.
 - a. Assemble each type of record document into electronically-indexed composite file.
 - 2. Record markups in layers separate from Architect's data file layer information.
- B. Record Drawings: Submit copies of record Drawings as annotated PDF electronic files of scanned record prints or record digital data files.
 - 1. Initial Submittal: Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - 2. Final Submittal: Submit each Drawing file, whether or not changes and additional information were recorded.
- C. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- D. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- E. 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.
- F. Reports: Submit written report indicating items incorporated into Project record documents concurrent with progress of Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain 1 set of marked-up paper copies of Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show 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 markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
2. Content: Types of items requiring marking include 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 original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on Work that is shown only schematically.
3. Mark 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 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 document with Architect. When authorized, prepare a full set of corrected digital data files of Contract Drawings as follows:
1. Format: Same digital data software program, version, and operating system as original Contract Drawings unless indicated otherwise.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Architect will furnish Contractor with 1 set of digital data files of 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 designation "PROJECT RECORD DRAWING" in a prominent location.
1. Format: Annotated PDF electronic file with comment function enabled.
 2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of Contract Drawings. Name each file with sheet identification. Include identification in each digital data file.
 3. Identification : As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."

- d. Name of Architect.
- e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate actual product installation where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain 1 copy of each submittal during 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 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 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.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

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

1.7 MAINTENANCE OF RECORD DOCUMENTS

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

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

SECTION 017900
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for instructing Owner's personnel, including the following:
 - a. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. 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.
2. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
3. 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.

B. Pre-Instruction Meeting: Conduct meeting at Project site. Review methods and procedures related to demonstration and training including 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.

1.3 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 knowledgeable about the Project and experienced in operation and maintenance procedures and training.

1.4 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.

1. Training Hours: Schedule the following minimum number of hours for training:
 - a. Building Automation System: 2 hours.
 - b. Fire Alarm System: 2 hours.
 - c. Security/Access Control System: 2 hours.
 - d. HVAC Systems and Controls: Number of hours as stipulated in Owner/Contractor agreement.
2. Training Modules: For each module, include instruction for the following as applicable to the system, equipment, or component:
 - a. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- 1) System, subsystem, and equipment descriptions.
 - 2) Performance and design criteria if Contractor is delegated design responsibility.
 - 3) Operating standards.
 - 4) Regulatory requirements.
 - 5) Equipment function.
 - 6) Operating characteristics.
 - 7) Limiting conditions.
 - 8) Performance curves.
- b. Documentation: Review the following items in detail:
- 1) Emergency manuals.
 - 2) Systems and equipment operation manuals.
 - 3) Systems and equipment maintenance manuals.
 - 4) Product maintenance manuals.
 - 5) Project Record Documents.
 - 6) Identification systems.
 - 7) Warranties and bonds.
 - 8) Maintenance service agreements and similar continuing commitments.
- c. Emergencies: Include the following, as applicable:
- 1) Instructions on meaning of warnings, trouble indications, and error messages.
 - 2) Instructions on stopping.
 - 3) Shutdown instructions for each type of emergency.
 - 4) Operating instructions for conditions outside of normal operating limits.
 - 5) Sequences for electric or electronic systems.
 - 6) Special operating instructions and procedures.
- d. Operations: 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) Control sequences.
 - 6) Safety procedures.
 - 7) Instructions on stopping.
 - 8) Normal shutdown instructions.
 - 9) Operating procedures for emergencies.
 - 10) Operating procedures for system, subsystem, or equipment failure.
 - 11) Seasonal and weekend operating instructions.
 - 12) Required sequences for electric or electronic systems.
 - 13) Special operating instructions and procedures.
- e. Adjustments: Include the following:
- 1) Alignments.
 - 2) Checking adjustments.
 - 3) Noise and vibration adjustments.
 - 4) Economy and efficiency adjustments.
- f. Maintenance: Include 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) Procedures for routine cleaning.
 - 5) Procedures for preventive maintenance.
 - 6) Procedures for routine maintenance.
 - 7) Instruction on use of special tools.
- g. Troubleshooting: Include the following:
- 1) Diagnostic instructions.
 - 2) Test and inspection procedures.
- h. Repairs: Include the following:

- 1) Diagnosis instructions.
- 2) Repair instructions.
- 3) Disassembly; component removal, repair, and replacement; and reassembly instructions.
- 4) Instructions for identifying parts and components.
- 5) Review of spare parts needed for operation and maintenance.

1.5 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 locations.

1.6 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.
- 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 minimum of 14 days prior to Substantial Completion.
- D. Training Location and Reference Material: Conduct training on-site in completed and fully operational facility using actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 018119
INDOOR AIR QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Administrative and procedural requirements governing protection of indoor air quality, absorbent materials, and mechanical system from contamination during demolition and building flush-out.
 2. Baseline indoor air quality testing prior to Owner occupancy

1.2 DEFINITIONS

- A. Absorptive Materials: Gypsum board, acoustical ceiling tile and panels, broadloom and tile carpet, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.3 ACTION SUBMITTALS

- A. Construction Indoor Air Quality (IAQ) Management Plan:
1. Credit IEQ 3 Construction IAQ Management Plan: An IAQ Management Plan based on SMACNA IAQ Guidelines. IAQ Management Plan shall describe in detail measures specific to this Project to be taken during construction to promote adequate indoor air quality upon completion.
 - a. HVAC Protection: Describe steps to protect ductwork and HVAC equipment from dust and water damage.
 - b. Source Control: Identify sources of VOCs and appropriate measures to mitigate their impacts.
 - c. Pathway Interruption: Manipulate air paths to reduce contaminants of finished spaces.
 - d. Housekeeping: Describe cleaning and dust control procedures.
 - e. Scheduling: Identify each interior finish that either generates odors, moisture, or vapors, or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
 2. Quality Assurance and IAQ Monitoring: Describe steps to ensure compliance by Contractor and Subcontractors.
- B. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors, or is susceptible to absorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Air Filters: MERV 8, minimum, when tested in accordance with ASHRAE Std 52.

PART 3 - EXECUTION

- A. Refer to SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.
- B. Building HVAC system and supply air ductwork may be used for ventilation during construction:
 - 1. Begin construction ventilation when building is substantially enclosed.
 - 2. Operate HVAC system with 100 percent outside air and with 1.5 air changes per hour, minimum.
 - 3. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
 - 4. Do not use return air ductwork for ventilation unless absolutely necessary.
 - 5. Where return air ducts are used for ventilation, install MERV 8 filters at return inlets, sealed to ducts. Replace filters when they lose efficiency.
- C. Prevent absorption of moisture and humidity and contamination of adsorptive materials by:
 - 1. Sequencing delivery of adsorptive materials so they are not present in building until wet Work is completed and dry.
 - 2. Delivering and storing adsorptive materials in fully sealed moisture-impermeable packaging.
 - 3. Providing sufficient ventilation for drying within reasonable time frame.
- D. HVAC Protection:
 - 1. Protect air handling and distribution equipment, and air supply and return ducting during demolition.
 - 2. Adequately cover and protect exposed air inlets and outlets, openings, grilles, ducts, and plenums as required to prevent water, moisture, and other contaminant intrusions.
 - 3. Apply protection immediately after installation of equipment and ducting.
 - 4. Do not store construction materials or waste in mechanical or electrical rooms.
 - 5. Prior to using return air ductwork without intake filters, clean up and remove dust and debris generated by construction activities.
 - 6. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 7. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes, and conduit.
 - 8. Clean tops of doors and frames.
 - 9. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 - 10. Clean return air plenums of air handling units.
 - 11. Remove air intake filters only after cleaning is complete.
 - 12. Do not perform dust or dirt-producing Work after starting use of return air ducts without intake filters on return air ducts.
- E. Pathway Interruption:
 - 1. Provide solid, physical barriers to isolate areas of construction. Securely attach and seal at floor and structure above.
 - 2. Seal openings within designated Work.
 - 3. Install adequate exhaust ventilation equipment to maintain negative pressure differential between Work areas and adjacent areas of building.
 - 4. Exhaust ventilation units to outside of building.
- F. Source Control:
 - 1. Limit construction traffic and motor idling in vicinity of air intake louvers when HVAC systems are activated. Restrict motor vehicles to loading dock area, well removed from air intakes and operable windows, preventing emissions from being drawn into building.
 - 2. Use electric or natural gas alternatives for gasoline and diesel equipment where possible and practical.
 - 3. Cycle equipment off when not being used or needed.

4. Avoid use of materials and products with high VOC and/or particulate levels. Use products and installation methods with low VOCs such as paints, sealers, sealants, filler materials, insulation, adhesives, and cleaners. Comply with requirements in other Specification Sections.
5. Keep containers of wet products closed as much as possible. Cover and seal waste materials, which can release odor or dust.
6. Protect materials, especially absorbent materials such as insulated ductwork and acoustical ceiling panels, against moisture during delivery to and storage at Project site. Store materials inside structure in a dry and clean environment pending installation. Keep building materials dry to avoid introduction of moisture into building interior.
7. Avoid use of moisture-damaged materials. Thoroughly dry porous materials that have been wetted before installation. Discard, porous materials that have been damaged, have remained wet longer than 48 hours, or show signs of visible mold.
8. Ensure that construction process will not result in moisture intrusion.
9. Avoid tracking pollutants into Work areas. Once framing and mechanical system installation starts, control access to building interior to minimize tracking in of contaminants. Route material deliveries and construction waste removal via most direct route to building exterior rather than through interior spaces.
10. Provide rough track-off grates or matting at entrances to remove moisture and containments from entering building.
11. Prevent ingress of rodents and pests.
12. Prohibit use of tobacco products during construction inside building and within 25 feet of building entrances.

G. Housekeeping:

1. Provide temporary ventilation during demolition to minimize accumulation of dust fumes, vapors, or gases in the building.
2. Suppress dust with wetting agents or sweeping compounds.
3. Clean up dust using a wet rag or damp mop.
4. Increase cleaning frequency when dust build-up is noted.
5. Remove spills or excess applications of solvent-containing products as soon as possible.
6. Remove accumulated water and keep Work areas as dry as possible.
7. Store and keep volatile liquid containers closed when container is inside of building and not in use.
8. HEPA vacuuming and duct cleaning.
9. Use nontoxic cleaning materials and procedures.

H. Scheduling:

1. Comply with scheduling requirements of Article, "Sequence of Finish Installation" of this Section.
2. Do not install porous or absorbent materials such as insulated ductwork and ceiling tiles until interior finishes (drywall finishing, painting, and floor finishing) have cured.
3. Phased Completion: Implement IAQ control measures in each air zone until construction in that area is complete. Do not allow contaminants from an area under construction to enter HVAC ductwork systems or to migrate to completed areas.
4. Filters: Install new MERV 8 filters at central fan system, immediately prior to first phase of building occupancy. Install new MERV 8 filters at fan systems serving limited areas immediately prior to occupancy for each respective area.

3.2 SEQUENCE OF FINISH INSTALLATION

A. Sequence of Finish Installation: Project schedule shall address construction scheduling and sequencing requirements and procedures necessary to optimize IAQ levels for completed Project.

1. Scheduling Contractor's Project Schedule for finish applications should allow for:
 - a. Dissipation of high emissions from finishes that off-gas perceptible quantities of deleterious material during curing

- b. Separation of off-gassing effects from installation of adsorptive materials that would act as a "sink" for storage and subsequent release of these unwanted substances into building spaces and mechanical systems after project occupancy.
 2. When Contractor's "Project Schedule" requires less than optimal sequencing of finish installation, related to IAQ, provide supplemental filtered "fresh air" ventilation of Work areas during construction and restrict and control use of permanent building mechanical systems prior to Owner's acceptance of building to prevent contamination of systems by construction wastes and other deleterious substances.
- B. Finish Types:
 1. Type 1: Materials and finishes that have a potential for short-term levels of off-gassing from chemicals inherent in their manufacturing process, or which are applied in a form requiring vehicles or carriers for spreading which release a high level of particulate matter in installation and/or curing process. Type 1 Finishes include the following:
 - a. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
 - b. Wood preservatives, finishes, and paint.
 - c. Control and/or expansion joint fillers.
 - d. Hard finishes requiring adhesive installation.
 - e. Gypsum board and associated finish processes.
 - f. Sealants and associated filler materials.
 2. Type 2: Finishes: Materials and finishes that are woven, fibrous, or porous in nature and tend to adsorb chemicals off-gassed by Type 1 finishes or may be adversely affected by particulates. These materials become "sinks" for deleterious substances, which may be released much later, or collectors of contaminants that may promote subsequent bacterial growth. Type 2 Finishes include the following:
 - a. Carpet and padding.
 - b. Fabric wallcovering.
 - c. Insulation exposed to the airstream.
 - d. Acoustic ceiling materials.
 - e. Fabric covered acoustic wall panels.
 - f. Upholstered furnishings.
 - g. Materials that can be categorized as both Type 1 and Type 2 materials shall be considered to be Type 1 materials.
- C. Optimal Order of Installation: Apply Type 1 interior finishes throughout entire controlled air zone of each enclosed building or building segment and allow such finishes to completely cure according to intervals and times stated in respective finish manufacturer's printed instructions before commencing installation of any Type 2 materials in same area.
 1. Do not store Type 2 materials in areas where installation or curing of Type 1 materials is in progress.
- D. Materials Test Data: Required for Substitutions only:
 1. For materials proposed for substitution, submit manufacturer's test data that indicates permanent, in-place Indoor Air Quality performance complying with this Section.
 2. Material Safety Data Sheets: Review MSDS's of materials to be submitted for testing as well as MSDS's for other products where specifically requested in Specification Sections and identify those classified as "Prohibited Materials".
 3. Prohibited Materials: Building materials or products that emit pollutants included on International Agency for Research on Cancer (IARC) "List of Chemical Carcinogens", "Carcinogen List" of the National Toxicology Program, and "Reproductive Toxin List" of "Catalog of Teratogenic Agents" shall have approval, in writing from Owner, before that building material or product may be used on this Project.
 - a. Carcinogens: Use of materials emitting carcinogens will not be permitted unless a suitable substitute is not available. Do not proceed with procurement of carcinogen-emitting products or materials without prior review and written approval of Owner.

END OF SECTION 018119

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. Salvage of existing items to be reused or recycled.

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 ADMINISTRATIVE REQUIREMENTS

- A. Predemolition Meeting: Conduct meeting at Project site.
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of Work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.5 INFORMATIONAL SUBMITTALS

- A. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 – Photographic Documentation. Submit before Work begins.
- B. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

- A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- C. Hazardous Materials: It is not expected that hazardous materials will be encountered in 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.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 PERFORMANCE CRITERIA

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.
- C. Sustainable Design Requirements for Building Reuse:
 - 1. Maintain existing building structure, envelope, and interior nonstructural elements of an abandoned or blighted building. Do not demolish such existing construction beyond indicated limits.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Engage a competent person to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as Work progresses to detect hazards resulting from selective demolition activities.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
 - 1. Inventory and record conditions of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.

2.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

2.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Utilities to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. 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.

2.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 – Temporary Facilities and Controls.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
 - 1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

2.5 SELECTIVE DEMOLITION, GENERAL

- A. Demolish and remove existing construction only to extent required by new construction and as indicated. Use methods required to complete 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 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 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 4 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. 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.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition, cleaned, and reinstalled in their original locations after selective demolition operations are complete.

2.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

2.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 – Construction Waste Management and Disposal or 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.
- B. Burning: Do not burn demolished materials.

2.8 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.
 - 1. Clean roadways of debris caused by debris transport.

2.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: See drawings.
- B. Remove and Salvage: See drawings.
- C. Remove and Reinstall:
 - 1. Refrigerator
 - 2. Large wall mounted TV in Conference room
 - 3. Wood chair rail and wood ceiling molding.
 - 4. Exterior blinds
- D. Existing to Remain: See drawings

END OF SECTION 024119

SECTION 061000
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Framing with dimension lumber.
 2. Shear wall panels.
 3. Wood blocking and nailers.
 4. Wood furring.
 5. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
1. Indicate component materials and dimensions.
 2. Include construction and application details.
 3. 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.
 4. 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.
 5. 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 D5664.
 6. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
- B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood products.
 2. Fire-retardant-treated wood products.
 3. Engineered wood products.
 4. Shear panels.
 5. Power-driven fasteners.
 6. Post-installed anchors.

- 7. Metal framing anchors.
 - B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.
- 1.5 QUALITY ASSURANCE
- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that materials bearing classification marking is representative of material tested.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Comply with DOC PS 20 and with applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by ALSC Board of Review. Grade lumber by an agency certified by ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, apply grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: As indicated on structural Drawings.
 - 1. 2 inch Nominal Thickness or Less: 15 percent.
 - 2. More Than 2 Inch Nominal Thickness: 19 percent unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- D. Lumber fabricated from old growth timber is not permitted

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide wood-preserved-treatment products from one of the following:
 - 1. Hoover Treated Wood Products, Inc.
 - 2. Koppers Performance Chemicals.
 - 3. Lonza.
 - 4. Viance – Treated Wood Solutions.
 - 5. Approved substitutions.
- B. Preservative Treatment by Pressure Process: AWPA U1 Use Categories as follows:

1. UC2: Interior lumber not in contact with ground but may be subject to dampness.
 2. UC3B: Exterior lumber not in contact with ground.
 3. UC4A: Exterior lumber in contact with ground.
- C. Preservative Chemicals: Acceptable to AHJ.
1. Do not use chemicals containing arsenic or chromium except as approved by AHJ for timber posts.
 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.
- D. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- E. Mark lumber with treatment quality mark of an inspection agency approved by ALSC Board of Review.
1. For exposed lumber indicated to receive stained or natural finish, mark end or back of each piece, or omit marking and provide certificates of treatment compliance issued by inspection agency if acceptable to inspection agency or authorities having jurisdiction.
- F. Application: Treat items indicated on Drawings, and the following:
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to interior of below-grade exterior masonry or concrete walls.
 4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
1. Species: As indicated on structural Drawings.
 2. Application: Interior, non-load-bearing partitions.
- B. Load-Bearing Partitions: Construction or No. 2 grade.
1. Species: As indicated on structural Drawings.
 2. Application: Exterior walls and interior load-bearing partitions.
- C. Joists, Rafters, and Other Framing Not Listed Above: Construction or No. 2 grade.
1. Species: As indicated on structural Drawings.

2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
 2. Nailers.
 3. Rooftop equipment bases and support curbs.
 4. Furring.
 5. Cants.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:
1. Western woods; WCLIB or WWPA, species as indicated on structural Drawings.
- C. Concealed Boards: 15 percent maximum moisture content of the following species and grades.
1. Western woods; WCLIB or WWPA, species as indicated on structural Drawings.

- 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, not less than 3/4 inch nominal thickness unless indicated otherwise.

2.6 FASTENERS

- A. Provide fasteners of size and type indicated, that comply with requirements specified in this Article for material and manufacture, and are acceptable to authorities having jurisdiction.
 - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, as appropriate for substrate, based on the following:
 - 1. Mechanical Anchors:
 - a. Masonry: ICC-ES AC01.
 - b. Concrete: ICC-ES AC193.
 - 2. Adhesive Anchors:
 - a. Masonry: ICC-ES AC58.
 - b. Concrete: ICC-ES AC308.
 - 3. Materials:
 - a. Carbon-Steel Components: Zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 - b. Stainless Steel with Bolts and Nuts: Comply with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
 - 6. Approved substitution.
- B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- C. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

- D. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2 inch minimum side cover.
 - 1. See Structural
- E. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
 - 1. See Structural
- F. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.
- G. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of 2 bolts placed 7 bolt diameters from reinforced base.
 - 1. See Structural

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1 inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- C. Flexible Flashing: Composite, self-adhesive, flashing product as specified in Section 076500 – Flexible Flashing.
- D. Installation Adhesives: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
 - 1. Application: For gluing furring and sleepers to wood, concrete, or masonry.
 - 2. [Verify VOC](#) content is 70 g/L or less.
- E. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
 - H. Do not splice structural members between supports unless otherwise indicated.
 - I. 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 [**and 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 on center.
 - J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches on center with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. 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 on center. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2 inch nominal thickness.
 - 3. Concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Concealed spaces behind combustible cornices and exterior trim at not more than 20 feet on center.
 - K. 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.
 - L. Apply copper naphthenate field treatment in compliance with AWPA M4, to cut surfaces of preservative-treated lumber.
 - 1. Application: Items not continuously protected from liquid water.
 - M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
 - N. Securely attach rough carpentry Work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. ICC-ES evaluation report for fastener.
 - O. 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.
 - P. For exposed Work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
 - 1. Comply with approved fastener patterns where applicable.
 - 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 - 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.
- 3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS
- A. Install where indicated and where required for attaching other Work. Form to shapes indicated and cut as required for true line and level of attached Work. Coordinate locations with other Work involved.

- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish Work.
- B. Furring to Receive Plywood or Paneling: Install 1 by 3 inch nominal-size furring at 24 inches on center
- C. Furring to Receive Gypsum Board: Install 1 by 2 inch nominal-size furring vertically at 16 inches on center

3.4 INSTALLATION OF WALL AND PARTITION FRAMING

- A. Provide single bottom plate and double top plates using members of 2 inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
 - 1. Exterior Walls: 2 by 6 inch nominal size wood studs spaced as indicated on structural.
 - 2. Interior Partitions and Walls: 2 by 4 inch nominal size wood studs spaced as indicated on structural on center unless otherwise indicated.
- B. Provide Construct corners and intersections with 3 or more studs, except that 2 studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
 - 1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4 inch nominal depth for openings 48 inches and less in width, 6 inch nominal depth for openings 48 to 72 inches in width, 8 inch nominal depth for openings 72 to 120 inches in width, and not less than 10 inch nominal depth for openings 10 to 12 feet in width.
 - 2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.
 - 3. Provide bracing as indicated on structural.

3.5 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather.
 - 1. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment.
 - 2. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather.
 - 1. If, despite protection, wood that becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment.
 - 2. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.2 PREINSTALLATION MEETINGS

- #### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

- #### A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.5 FIELD CONDITIONS

- #### A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity as required per manufacturer during the remainder of the construction period.

PART 2 - PRODUCTS

- #### 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. Approved General Contractor Casework Sub.

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
- B. Type of Construction: Frameless
- C. Door and Drawer-Front Style: Flush overlay.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- E. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS
 - 4. Edges: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish
 - 5. Pattern Direction: As specified by Architect.
- F. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130
 - 2. Particleboard (Medium Density): ANSI A208.1, Grade M-2
 - 3. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets as specified in construction documents except for items specified in Section 087100 "Door Hardware.
- B. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated. Refer to construction documents for finish.
- C. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.5 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

END OF SECTION 064116

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Elastomeric joint sealants.
 2. Mildew-resistant joint sealants.
 3. Joint sealant backing.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Conduct meeting at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2 inch wide joints formed between two 6 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- C. Sealant Schedule: Submit schedule of sealant applications listing joint sealants proposed for this Work and materials to which joint sealants are specified to be applied. Obtain Architect's written approval of this sealant schedule before starting Work of this Section.
1. Joint-Sealant Schedule: Include the following information:
 - a. Joint-sealant application, joint location, and designation.
 - b. Joint-sealant manufacturer and product name.
 - c. Joint-sealant formulation.
 - d. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by qualified testing agency. Include the following information for each joint sealant and substrate material to be tested:
1. Joint-sealant location and designation.
 2. Manufacturer and product name.
 3. Type of substrate material.
 4. Proposed test.
 5. Number of samples required.
- C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- E. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers who are trained and approved by sealant manufacturer with a minimum 5 years of documented experience performing work similar in scale and scope to this Project.
 - 1. Single Source Responsibility: Provide field-installation of exterior joint sealers specified in this Section under responsibility of a single installer.
- B. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct testing indicated.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Build mockups in compliance with Section 014339 – Mockups and to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Install sealants in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
 - 2. Conduct mockups of joint sealing systems specified in this Section as part of system mockups as specified by related Sections for purpose of verifying visual appearance, water and air infiltration testing, conducting pull tests to determine correct use of cleaning and primers, and to aid in determining general adequacy of system design.
 - 3. Include concrete systems, masonry mockup walls, wall cladding, roofing and waterproofing systems, and window systems.
 - 4. Include system components including backing materials and bond breakers.
 - 5. Verify need for primers and other preinstallation preparation for each surface.
 - 6. Inspect mockups after 14 days and perform pull test under supervision of manufacturer's representative to determine suitability and primer requirements.
 - 7. Make adjustments as needed for acceptance conforming to manufacturer's instructions and provisions of Contract Documents.
 - 8. Protect accepted mockup as quality standard for Work of this Section.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry **[and] [stone]** substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.

5. Schedule sufficient time for testing and analyzing results to prevent delaying Work.
 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 2. Conduct field tests for each kind of sealant and joint substrate.
 3. Notify Architect 7 days in advance of dates and times when test joints will be erected.
 4. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 5. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 6. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
 - a. Test Method: Test joint sealants per Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately: extend cut along 1 side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 7. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
 8. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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: 5 years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 5 years [**20 years**] from date of Substantial Completion.
- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of structure caused by stresses on sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural 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. 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.
 1. Verify sealants have a VOC content of 250 g/L or less.
 2. Verify sealants comply with testing and product requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.
 1. Where color is indicated to "match adjacent substrates" or "match existing," provide either manufacturer's standard color if matching color is available, or, if not available, provide field-tintable custom color.

2.2 JOINT SEALANTS TYPES

- A. Silicone (Type S1): Nonstaining, single-component, nonsag, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT, G, A, and O.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. C.R. Laurence Co., Inc.: Catalog No. 95CBL.
 - b. Dow Chemical Company: Dowsil 795.
 - c. Momentive Performance Materials, Inc.: GE SCS9000 Silpruf NB.
 - d. Momentive Performance Materials, Inc.: GE SCS2000 SilPruf.
 - e. Pecora Corporation: 864NST.
 - f. Sika Corporation: Sikasil WS-295 Sikasil C995.
 - g. Tremco Incorporated: Spectrem 2.
 2. Color: As selected by Architect from manufacturer's full color range.
- B. Silicone, Mildew Resistant, Acid Curing (Type S2): Mildew-resistant, single-component, nonsag, nontraffic-use, acid-curing silicone joint sealant, USDA or NSF approved; ASTM C920, Type S, Grade NS, Class 25, Use NT; Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company: Dowsil 786.
 - b. ITW Polymers Sealants North America: Acryl-R SM8500.
 - c. Momentive Performance Materials, Inc.: GE SCS1700 Sanitary.
 - d. Pecora Corporation: 898NST Sanitary Silicone.
 - e. ~~Polymeric Systems, Inc.: PSI-601 or PSI-601 FG.~~
 - f. Sika Corporation: Sikasil-GP.
 - g. Tremco Incorporated: Tremsil 200.
 2. Color: Clear unless indicated otherwise.
- C. Structural Glazing Sealants (Type S3): Chemically curing silicone formulation that is compatible with system components with which it comes into contact; ASTM C920, Type S, Grade NS, Class 25, Use NT, G, and A; ASTM C1184, Use G, and A. Specifically formulated and tested for use as

structural sealant and approved by structural-sealant manufacturer for use in aluminum-framed assemblies indicated.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company: Dowsil 995 Silicone Structural Sealant.
 - b. Momentive Performance Materials, Inc.: GE SCS2000 SilPruf.
 - c. Pecora Corporation: 895NST.
 - d. Sika Corporation: Sikasil WS-295 or Sikasil SG-20.
 - e. Tremco Incorporated: Proglaze SSG. Proglaze II.
 - f. Approved substitution.
 2. Performance Requirements:
 - a. Tensile Strength: 300 psi, at 100 percent elongation; ASTM D412.
 - b. Tear Strength: 45 pli; ASTM D624.
 - c. Peel Strength: 40 pli: ASTM C794.
 3. Hardness: 40 durometer minimum; ASTM C661Shore A.
 4. Volatile Organic Compound (VOC) Content: 100 g/L maximum.
 5. Staining, ASTM C1248: No staining on concrete, marble, granite, limestone, and brick.
 6. Color: As selected by Architect from manufacturer's full range of colors.
- D. Silicone (Type S4): Neutral-curing silicone glazing sealant; with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company: Dowsil 790 Silicone Building Sealant.
 - b. Momentive Performance Materials, Inc.: GE SCS2700 SilPruf LM.
 - c. Pecora Corporation: 890NST.
 - d. Sika Corporation: Sikasil WS-290 Sikasil C990.
 - e. Tremco Incorporated: Spectrem 1.
- E. Silicone (Type S5): Neutral-curing, single-component, nonsag, nontraffic-use sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company: Dowsil 758 Silicone Weather Barrier Sealant.
 - b. Momentive Performance Materials, Inc.: GE SSG4000 UltraGlaze or GE SSG4000AC UltraGlaze.
 - c. Pecora Corporation: 896 ABV Silicone.
 - d. Polymeric Systems, Inc.: PSI-613.
 - e. Sika Corporation: Sikasil-N Plus US.
 - f. Tremco Incorporated: S Proglaze SSG.
 - g. VaproShield LLC: VaproBond.
- F. Urethane (Type U1): Single-component, pourable, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25/35, Uses T, M, A, O, and I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal SL 1.
 - b. Pecora Corporation: Urexpam NR-201.
 - c. Polymeric Systems, Inc.: Flexiprene PSI-952.
 - 1) specifically developed for sealing horizontal joints of dissimilar porosities, coefficients of expansion and surface textures including joints in plazas, malls, parking decks, pavements, driveways, factory and institutional joints. It has proven successful as a traffic loop sealant
 - d. Sherwin-Williams Company (The): Loxon SL1.
 - e. Sika Corporation: Sikaflex 1c SL.
 - f. Tremco Incorporated: Vulkem 45SSL.

- G. Urethane (Type U2): Multicomponent, pourable, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T, NT, M, A, and I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal SL 2.
 - b. Pecora Corporation: Dynatrol II SG or Urexpam NR-200.
 - c. Sherwin-Williams Company (The): Loxon SL2.
 - d. Sika Corporation: Sikaflex 2c SL.
 - e. Tremco Incorporated: THC 901.
- H. Urethane (Type U3): Multicomponent, nonsag, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal NP 2.
 - b. Pacific Polymers International, Inc.: Elasto-Thane 227.
 - c. Sherwin-Williams Company (The): Loxon NS2.
 - d. Sika Corporation: Sikaflex 2c NS.
 - e. Tremco Incorporated: Dymeric 240 FC NP 2.
- I. Urethane, Textured (Type U4): Single-component, nonsag, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT, G, M, A, and O.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal TX1.
 - b. Pecora Corporation: Dynatrol I-XL.
 - c. Sherwin-Williams Company (The): Loxon TX.
 - d. Sika Corporation: Sikaflex Textured Sealant.
 - e. Tremco Incorporated: Dymonic.
 - 2.
- J. Urethane (Type U5): Multicomponent, nonsag, nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal NP 2.
 - b. Sherwin-Williams Company (The): Loxon NS2.
 - c. Approved substitution.
- K. Acrylic Latex (Type AL1): Acrylic latex or siliconized acrylic latex, paintable after cure, ASTM C834, Type OP, Grade NF.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Systems: MasterSeal NP 520.
 - b. Pecora Corporation: AC-20+ Silicone.
 - c. Sherwin-Williams Company (The): PowerHouse Siliconized Acrylic Latex Caulk.
 - d. Tremco Incorporated: Tremflex 834.
 2. Color: Match adjacent finish surfaces.
- L.
- M.
- N. Butyl-Rubber-Based Joint Sealant (Type BR1): Single, component, non-skinning, butyl-based, solvent release sealant; ASTM C1311, Class 12-1/2.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Pecora Corporation: BC-158.
 - b. Premier Building Solutions: XtraBond 1500.
 - c. Tremco Incorporated: Tremco Butyl Sealant.
 2. Performance Requirements:
 - a. Movement Capability: Plus/minus 12-1/2 percent.
 - b. Service Temperature Range: 13 to 180 deg F.

- c. Shore A Hardness Range: 10 to 30.

2.3 JOINT-SEALANT BACKING

- A. Joint Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; as approved in writing by joint-sealant manufacturer, for joint applications indicated based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330; Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Cylindrical Sealant Backings: ASTM C1330; any of the following 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.
1. Type B (bicellular material with surface skin):
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Armacell LLC: FillPro Soft Type Backer Rod.
 - 2) Backer Rod Manufacturing Inc.: Titan Foam.
 - 3) BASF Construction Systems: MasterSeal 921.
 - 4) Nomaco Engineered Foam Solutions: SOF Rod Bi-Cellular Backer Rod.
 2. Type C (closed-cell material with a surface skin):
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Armacell LLC: FillPro Standard Backer Rod.
 - 2) Backer Rod Manufacturing Inc.: Mile High Foam.
 - 3) BASF Construction Systems: MasterSeal 920.
 - 4) Nomaco Engineered Foam Solutions: HBR Closed Cell Backer Rod.
 3. Type O (open-cell material):
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Armacell LLC: FillPro Open Cell Backer Rod.
 - 2) Backer Rod Manufacturing Inc.: Denver Foam.
 - 3) Nomaco Engineered Foam Solutions: OC Foam Open-Cell Backer Rod.
- D. Type 4 Secondary Sealant Backing: Precompressed, self-expanding, high-density polyurethane foam tape joint sealant. Size as appropriate for movement capacity indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Balco, Inc.: BBSW Wall Compression Seals.
 - b. EMSEAL Joint Systems, Ltd.: Backer Seal.
 - c. Schul International Company, Inc.: Sealtite B.
 - d. Tremco Incorporated:
 - e. Willseal LLC: Willseal 600S.
 2. Color: Grey or black.
 3. Movement Capability: 100 percent (-50/+50 percent) according to ASTM D3574, unless indicated otherwise.
 4. Applications: Secondary joint sealant backing material at vertical wall expansion joints.
- E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove 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), existing 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

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants per requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Owner will engage qualified testing agency to 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 1,000 feet of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1,000 feet of joint length thereafter or 1 test per each floor per elevation.
 - 2. Test Method: Test joint sealants per Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - 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 passes 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 fill, sealant configuration, and sealant dimensions.
 - B. 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.
 - C. 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 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.
- 3.7 INTERIOR JOINT-SEALANT SCHEDULE
- A. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal, nontraffic surfaces:
 - 1. Joint-Sealant Type S2
 - 2. Joint Locations:
 - a. Joints between plumbing fixtures, including countertops, vanities, tubs, showers, and other locations subject to moisture.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 - B. Joint-Sealant Application: Interior joints in vertical surfaces.
 - 1. Joint-Sealant Type S4.
 - 2. Joint Locations:
 - a. Perimeter joints between wall surfaces and frames of doors.
 - C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces:
 - 1. Joint-Sealant Type U1.
 - 2. Joint Locations:
 - a. Interior horizontal traffic joints.
 - b. Paving and flooring control.
 - c. Floor expansion joints.
 - d. Other joints as indicated on Drawings.

- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
1. Joint-Sealant Type AL1.
 2. Joint Locations:
 - a. Nonmoving Interior gypsum board wall and ceiling control joints.
 - b. Perimeter joints between interior wall surfaces and frames of doors.
 - c. Other joints as indicated on Drawings.
 3. Typical Locations: General purpose interior caulking for gypsum board abutments to adjacent materials and for acoustical sealant. Wall and Ceiling Joints not subject to Movement, and other areas recommended by sealant manufacturer based on project materials

END OF SECTION 079200

SECTION 081213
HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. Interior standard steel frames.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to SDI A250.8.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate installation of anchorages 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.
 2. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.
- B. Preinstallation Meeting: Conduct meeting at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:
1. Elevations of each frame type.
 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 3. Locations of reinforcement and preparations for hardware.
 4. Details of each different wall opening condition.
 5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal frames, prepared by or under supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of fire-rated hollow-metal frame assembly, fire-rated borrowed-lite assembly, and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal frames 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. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum 4 inch high wood blocking. Provide minimum 1/4 inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Standard Steel Frames:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Baron Metal Industries, Inc. ; an Assa Abloy Group company.
 - b. Ceco Door Products; an Assa Abloy Group company.
 - c. Curries Company; an Assa Abloy Group company.
 - d. De La Fontaine Inc.
 - e. Pioneer Industries, Inc.
 - f. Steelcraft; an Allegion Brand.
 - g. Approved substitution.
- B. Source Limitations:
 - 1. Obtain hollow-metal Work from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite 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 according to NFPA 257 or UL 9.
- C. Thermally Rated Assemblies: Provide assemblies with R-Value of not less than 2.53 when tested according to ASTM C1363.

2.3 STANDARD STEEL FRAMES, GENERAL

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Provide hollow-metal door and frame types at locations indicated in Door Schedule.

2.4 INTERIOR STANDARD STEEL FRAMES

- A. Frames for Interior Wood Doors: SDI A250.8, Level 3; SDI A250.4, Level A.
 - 1. Materials: Uncoated steel sheet, minimum 0.053 inch thick.

2. Construction: Face welded.

2.5 PREFINISHED STEEL FRAMES

- A. Prefinished, knock-down, steel frames designed for installation by slipping frames over interior finished wall; anchoring frames in place, then snapping casing in place to conceal fasteners.
 1. Non-Fire Rated Frames:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dunbarton Corporation: Rediframe DW Hollow Metal Drywall Frame:
 - 2) Timely Industries, A Division of SDS Industries, Inc.: "S" Series.
 2. Fire Rated Frames:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dunbarton Corporation: Rediframe Fixed Throat X Series Steel Door Frame:
 - 2) Timely Industries, A Division of SDS Industries, Inc.: "CK" Series:
- B. Material:
 1. Non-Fire-Rated Frames: Uncoated steel sheet, minimum 0.032 inch thick.
 2. Fire-Rated Frames: Uncoated steel sheet, minimum 0.042 inch thick.
 3. Exterior Frames: Metallic-coated steel sheet, 0.042 inch thick, minimum A40 coating.
- C. Frame Profiles: Manufacturer's standard for each frame type.
- D. Casings:
 1. Steel: Minimum 0.034 inch thick cold rolled steel; 1-1/2 inch wide.
 2. Aluminum: Minimum 0.050 inch thick aluminum extrusion of 6063-T5 alloy; 1-1/2 inch wide.
 3. S56 Steel Colonial: Minimum 0.028 inch thick metallic-coated steel; 2-1/4 inch wide.
 4. Wood: As specified in Section 0664023 – Interior Architectural Woodwork.
- E. Corner Alignment Clips: Minimum 0.034 inch thick, prefinished, cold-rolled steel.

2.6 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - b. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
 - c. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.
 2. Quantity: Minimum of 3 anchors per jamb, with 1 additional anchor for frames with no floor anchor. Provide 1 additional anchor for each 24 inches of frame height above 7 feet.
 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011; hot-dip galvanized according to ASTM A153, Class B.

2.7 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus 1/2 of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153.
- 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. Foamed-in-Place Insulation: Manufacturer's standard, closed cell, spray-applied polyurethane type.
- H. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool.
 - 1. Surface Burning Characteristics: Passes when tested according to ASTM E136 for combustion characteristics
 - a. Flame Spread: 25.
 - b. Smoke Developed: 50.
- I. Glazing: Comply with requirements in Section 088000 – Glazing.
- J. Metal Patching Compound: Metal-filled, 2-component epoxy putty designed for use on various metal substrates.

2.8 FABRICATION

- A. Fabricate hollow-metal Work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify Work that cannot be permanently factory assembled before shipment.
- B. Provide frames receiving electrified hardware with 1/2 inch flexible steel conduit, including sufficient number of conductor wires, to accommodate electric function specified; connectors, and cover box installed at each location electrified hardware is specified.
 - 1. Properly coordinate installation of mechanical hardware and hook-up of electrified function with company that is licensed by Washington Electricity Board to prevent voiding of manufacturer's warranty and labeling of opening.
- C. Hollow-Metal Frames: Fabricate in 1 piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Provide frames with 1/8 inch integral kerf formed into frame soffit to accept weatherstripping for exterior openings and smoke gaskets for fire-rated openings.
 - a. Ship weatherstripping and smoke gaskets loose for installation after frames have been finished painted.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Thermal Breaks Fabricate frames with minimum 1/16 inch positive thermal break and integral vinyl weatherstripping as required to meet specified door assembly U-values.
 - 4. Faces: 2 inch.

5. Rabbets: Double 5/8 inch unless indicated otherwise.
 6. Backbends:
 - a. Wrap-Around Frames: Manufacturer's standard 1/2 inch nominal backbend.
 - b. Butted Frames: Custom 1-1/2 inch minimum backbends.
 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 3 door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive 2 door silencers.
- D. Prefinished Steel Frames:
1. Fabricate frames for swing doors, borrowed lites, and sidelights pre-cut and notched.
 2. JReinforcement Plate: 0.067 inch thick steel tapped for machine screws furnished with hinges. Mechanically attach reinforcement plate to hinge emboss.
 3. Provide frames with 1/8 inch integral kerf formed into frame soffit to accept weatherstripping for exterior openings and smoke gaskets for fire-rated openings.
 - a. Ship weatherstripping and smoke gaskets loose for installation after frames have been finished painted.
 4. Casing Clips: Factory-applied, heat-treated clips to ensure corner alignment and no deflection in clip upon installation or removal of casing.
 5. Provide notches, tabs, and stops for positive alignment of frame parts at corners.
 6. Provide manufacturer's standard brackets, glass stops, channels, and structural supports.
- E. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, Door Hardware Schedule, and templates.
1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.
- 2.9 STEEL FINISHES
- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Exterior Frames: After installation of anchor bolts is completed, fill dimpled anchor openings with metal patching compound. Cure and prep patching compound as recommended by patching compound manufacturer; ready for painting.
 - 3. Fire-Rated Openings: Install frames according to NFPA 80.
 - 4. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 5. Prefinished Steel Frames:
 - a. Install casings on frames.
 - b. Install silencers on interior frames.
 - c. Install weatherstripping on exterior frames.
 - d. Install smoke gaskets where required by hardware sets.
 - 6. Fill inside of frames with spray-applied foam insulation.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 088000 – Glazing and with hollow-metal manufacturer's written instructions.

3.4 REPAIR

- A. Replace frames that are damaged or that do not comply with requirements. Frames may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.
- B. Touchups:
 - 1. Prime-Coat: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - 2. Metallic-Coated Surface: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
 - 3. Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

3.5 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.

3.6 CLEANING

- A. Remove temporary coverings and protection of adjacent Work areas.
- B. Clean installed products in accordance with manufacturer's instructions prior to Substantial Completion. Remove excess sealants, glazing materials, dirt, and other substances.

3.7 PROTECTION

- A. Protect installed products from damage during remainder of construction activities.

END OF SECTION 081213

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. 5-ply flush wood veneer-faced doors for opaque finish.
 2. Factory priming flush wood doors.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Conduct meeting at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
1. Door core materials and construction.
 2. Door edge construction
 3. Door face type and characteristics.
 4. Door louvers.
 5. Door trim for openings.
 6. Door frame construction.
 7. Factory-machining criteria.
 8. Factory-finishing specifications.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
1. Door schedule indicating door location, type, size, and swing.
 2. Door elevations, dimension and locations of hardware.
 3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 4. Dimensions and locations of blocking for hardware attachment.
 5. Dimensions and locations of mortises and holes for hardware.
 6. Configuration of Dutch-type doors.
 7. Clearances and undercuts.
 8. Requirements for veneer matching.
 9. Doors to be factory-finished and application requirements.
- C. Samples for Verification:
1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
1. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons, and wrap bundles of doors in plastic sheeting.
 - 1. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than 1 week. Break seal on site to permit ventilation.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for remainder of construction period.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include the following:
 - a. Delamination of veneer.
 - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. ASSA ABLOY Wood Doors.
 - 2. Eggers Industries.
 - 3. Lynden Door, Inc.
 - 4. Masonite Architectural.
 - 5. Oregon Door.
 - 6. Vancouver Architectural Doors.
 - 7. VT Industries, Inc.

- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
 - 1. Contract Documents may contain requirements that are more stringent than referenced quality standard. Comply with Contract Documents in addition to those of referenced quality standard.
- B. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Composite Wood Products: Products shall be made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

2.3 SOLID-CORE FIVE-PLY FLUSH WOOD DOORS FOR OPAQUE FINISH

- A. Interior Doors:
 - 1. Performance Grade: WDMA ANSI/I.S. 1A
 - a. Extra Heavy Duty: Primary office entries, public restrooms, janitorial closets, assembly spaces
 - b. Heavy Duty: Typical U.N.O., private offices
 - c. Standard Duty: Closets
 - 2. ANSI/WDMA I.S. 1A Grade: Custom.
 - 3. Faces: Any closed-grain hardwood of mill option.
 - 4. Exposed Vertical and Top Edges: Any closed-grain hardwood.
 - 5. Construction: Agrifiber or particleboard core.
 - 6. Blocking: Provide wood blocking as needed to eliminate through-bolting hardware.

2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
 - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
 - 1. Locate hardware to comply with DHI-WDHS-3.
 - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 - 3. Coordinate with Section 081473 – Sliding Wood Doors for sliding door hardware to obtain manufacturer's templates required for factory machining.
 - 4. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 - 5. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 - 6. 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.
3. Louvers: Factory install louvers in prepared openings.
4. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

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. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Factory-Fitted Doors: Align and fit doors in frames with uniform clearances bevels at each edge:
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Provide inspection of installed Work through WDMA Hallmark Certification Program, certifying that wood doors and frames, including installation, comply with requirements of WDMA's for specified grade.
 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 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.

3.5 PROTECTION

- A. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at time of Substantial Completion.
 - 1. Remove doors damaged during installation and replace with new doors.

END OF SECTION 081416

SECTION 083113
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access doors and frames for walls and ceilings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed Work, and indicate in schedule specified in "Submittals" Article.
- B. Ceiling Coordination Drawings:
 - 1. Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings if applicable, material, individual components and profiles, and finishes.
- B. Product Schedule: For access doors and frames. Use same designations indicated on Drawings if indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspecting agency.
 - 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, section 5.2.3.1.

1.5 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire- protection ratings indicated, according to NFPA 252 or UL 10B.
- B. Design Requirements:

1. Door Sizes, General: Provide access doors and frames in the following sizes, unless indicated otherwise:
 - a. Walls: 12 inch square. 24 inch square for "reach in" access.
 - b. Ceilings: 24 by 24 inch or 22 by 30 inch.
2. Smoke Gaskets: Face of door flush with frame, gasketed, with concealed flange for gypsum board installation. Provide gaskets for access door and frame assemblies in the following locations:
 - a. Isolation rooms.
 - b. Rooms with negative pressure.
 - c. Exterior locations.

2.3 NON-RATED ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flange:

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis: BNT.
 - b. JL Industries, Inc.; Div. of Activar Construction Products Group: TM.
 - c. Karp Associates, Inc.: Model DCS-214M.
 - d. Larsen's Manufacturing Company: L-DW.
 - e. Milcor Company: M Series.
 - f. Nystrom, Inc.: NT.
 - g. Williams Brothers Corporation of America: WB-UAD-200.
2. Description: Face of door flush with frame, with minimum 1 inch exposed flange and concealed hinge.
3. Door Material:
 - a. Uncoated Steel Sheet for Door: Nominal 0.060 inch, factory primed.
4. Frame Material: Same material, thickness, and finish as door.
5. Latch and Lock: Prepared for mortise cylinder Cam latch, screwdriver operated.
6. Locations:
 - a. Walls: Interior gypsum board.
 - b. Ceilings: Interior gypsum board.

B. Flush Access Doors with Concealed Flanges:

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Babcock-Davis: BNW.
 - b. JL Industries, Inc.; Div. of Activar Construction Products Group: TMW.
 - c. Karp Associates, Inc.: Model KDW.
 - d. Larsen's Manufacturing Company: L-DWB.
 - e. Milcor Company: DW Standard Flush Door.
 - f. Nystrom, Inc.: NW.
 - g. Williams Brothers Corporation of America: WB-WD 400 Series.
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Door Material:
 - a. Uncoated Steel Sheet for Door: Nominal 0.060 inch, factory primed.
4. Frame Material: Same material, thickness, and finish as door.
5. Latch and Lock: Prepared for mortise cylinder Cam latch, screwdriver operated.
6. Locations:
 - a. Walls: Interior gypsum board.
 - b. Ceilings: Interior gypsum board.

C. Recessed Access Doors with Concealed Flanges

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Acudor Products, Inc.: DW-5058 Recessed Access Door.
 - b. Babcock-Davis: BRW.

- c. JL Industries, Inc.; Div. of Activar Construction Products Group: Style CTW.
- d. Karp Associates, Inc.: Model RDWPD.
- e. Larsen's Manufacturing Company: Model L-AT-GB.
- f. Milcor Company: Recessed Drywall Access Door (DWR).
- g. Nystrom, Inc.: RW.
- h. Williams Brothers Corporation of America: WB RDW 410.
2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. [
4. Locations:
 - a. Walls: Interior gypsum board.
 - b. Ceilings: Interior gypsum board.
5. Door Material:
 - a. Uncoated Steel Sheet for Door: Nominal 0.060 inch, factory primed.
6. Stainless Steel Sheet for Door: Nominal 0.062 inch, ASTM A480 No. 4 finish.
7. Latch and Lock: Prepared for mortise cylinder Cam latch, screwdriver operated.

2.4 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Acudor Products, Inc.: FW-5050.
 - b. Babcock-Davis: BIT.
 - c. JL Industries, Inc.; Div. of Activar Construction Products Group: FD Series.
 - d. Karp Associates, Inc.: KPR-150FR.
 - e. Larsen's Manufacturing Company: L-FRC.
 - f. Milcor Company: UFR.
 - g. Nystrom, Inc.: IT.
 - h. Williams Brothers Corporation of America: WB-FR 800 Series.
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. Door Material: Nominal 0.040 inch uncoated steel sheet, factory primed.
4. Frame Material: Nominal 0.060 inch uncoated steel sheet, factory primed.
5. Fire-Resistance Rating: Not less than that of adjacent construction that indicated unless indicated otherwise.
6. Latch and Lock: Self-latching door hardware, prepared for mortise cylinder.
7. Locations: Interior gypsum board walls and ceilings.

B. Fire-Rated, Flush Access Doors and Concealed:

1. Products: Subject to compliance with requirements, provide products by one of the following:
 - a. Acudor Products, Inc.: FW-5050-DW.
 - b. Babcock-Davis: BIW.
 - c. JL Industries, Inc.; Div. of Activar Construction Products Group: FDW Series.
 - d. Karp Associates, Inc.: KPR-350FR.
 - e. Milcor Company: UFR-DW.
 - f. Nystrom, Inc.: IW.
 - g. Williams Brothers Corporation of America: WB-FR-DW 820 Series.
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. Door Material: Nominal 0.040 inch uncoated steel sheet, factory primed.
4. Frame Material: Nominal 0.060 inch uncoated steel sheet, factory primed.
5. Fire-Resistance Rating: Not less than that of adjacent construction that indicated unless indicated otherwise.
6. Latch and Lock: Self-latching door hardware, prepared for mortise cylinder.

7. Locations: Interior gypsum board walls and ceilings.

2.5 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879, with cold-rolled steel sheet substrate complying with ASTM A1008, Commercial Steel (CS), exposed.
- C. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS) Type B; with minimum G60 or A60 metallic coating.
 - 1. Provide access doors and frames with metallic-coated steel sheet at exterior soffit locations in lieu of uncoated steel sheet
- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines or blend into finish.
 - 1. Finish: Directional Satin Finish, No. 4.
- E. Gaskets: Manufacturer's standard urethane, neoprene, or santoprene gasket designed to form smoke seal between door and frame.
- F. Frame Anchors: Same type as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel per ASTM A153 or ASTM F2329.

2.6 FABRICATION

- A. Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in 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 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 board securely attached 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 2 keys per lock and key all locks alike.
 - 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 – Door Hardware.

2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical 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 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.
 - a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 ADJUSTING

- A. Adjust doors and hardware after installation for proper operation.

END OF SECTION 083113

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sliding, transaction security windows.

1.2 COORDINATION

- A. Coordinate installation of anchorages for security windows. 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 adjacent construction.

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, weights and finishes for window units.
- B. Shop Drawings: For security windows.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
 - 3. Location of weep holes.
 - 4. Hardware for sliding window units.
 - 5. Glazing details.
 - 6. Details of transaction counter.
 - 7. Joinery.
 - 8. Anchorage.
 - 9. Glazing.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each type of security window and accessory indicated as ballistics or forced-entry resistant, for tests performed by a qualified testing agency.

- C. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F1233.
- D. Examination reports documenting inspections of substrates, areas, and conditions.
- E. Anchor inspection reports documenting inspections of built-in and cast-in anchors.
- F. Field quality-control reports documenting inspections of installed products.
 - 1. Field quality-control certification signed by Contractor.
- G. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label security window packaging with drawing designation.
- C. Store crated security windows on raised blocks to prevent moisture damage.

1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including deflections exceeding **1/4 inch (6 mm)**.
 - b. Failure of welds.
 - c. Excessive air leakage.
 - d. Faulty operation of sliding window hardware.
 - e. Faulty operation of transom drawers.
 - f. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
 1. Ballistics Resistance, UL 752: Listed and labeled as Level 3 in accordance with UL 752.

2.2 SLIDING, TRANSACTION SECURITY WINDOWS

- A. Provide sliding, transaction security windows.
 - A. Basis of Design: SLH Manual Horizontal Sliding Transaction Window by Insulgard Security Products; Phone 800.624.6315; website www.insulgard.com
 1. Insulgard Security Products: SLH Manual Horizontal Sliding Transaction Window system
 - a. Level 3: 1 ¼" Lexgard SP1250
 - b. Size: As indicated on drawings
 2. Approved equal
- B. Configuration: One fixed-glazed panel and one horizontal-sliding glazed panel.
- C. Operation: Manual open/manual closing.
- D. Framing: Fabricate perimeter framing, mullions, and glazing stops from aluminum as follows:
 1. Profile: Manufacturer's standard, with minimum face dimension indicated.
 2. Depth: Manufacturer's standard to achieve required ratings.

2.3 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
 1. Provide units that are reglazable from the secure side without dismantling the attack side of framing.
 2. Prepare security windows for field glazing unless preglazing at the factory is indicated.
- B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.
- C. Glazing Stops: Finish glazing stops to match security window framing.
 1. Attack-Side (Exterior) Glazing Stops: Welded or integral to framing.
 2. Secure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.
- D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- F. Factory-cut openings in glazing for speaking apertures.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 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.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 ACCESSORIES

- A. Recessed Deal Trays: Formed from stainless steel; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.
 1. Bullet Trap Location: Secure side.
 2. Ballistics Resistance: UL Level 3.
 3. Listed and labeled as bullet resisting in accordance with UL 752.
- B. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.
- C. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum **3/16 inch (4.8 mm)** thick; with minimum **1/2-inch- (12.7-mm-)** diameter, headed studs welded to back of plate.

- D. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- E. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B633; provide sufficient strength to withstand design pressures indicated.
- F. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant remains permanently elastic, nonshrinking, and nonmigrating.

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 security windows.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.
- D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
 - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
 - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For factory-installed glazing materials whose orientation (secure or attack side) is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.
- B. Voice-Communication-Type Framing: See manufacturer attachment requirements.
- C. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.

- D. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.
 - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
 - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.
- E. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.3 FIELD QUALITY CONTROL

- A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.
- B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.
- C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 ADJUSTING

- A. Adjust horizontal-sliding, transaction security windows to provide a tight fit at contact points for smooth operation and a secure enclosure.
- B. Adjust transaction drawers to provide a tight fit at contact points[**and weather stripping**] for smooth operation and[**weathertight and**] secure enclosure.
- C. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
 - 1. Lubricate sliding security window hardware.
- B. Clean glass of preglazed security windows promptly after installation. Comply with requirements of manufacturer.
- C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain operable security windows.

END OF SECTION 085653

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Aluminum-Framed Entrances and Storefronts"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature

4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
 - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:

- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
5. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
 - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Final approved hardware schedule edited to reflect conditions as installed.
 - d. Final keying schedule

- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
 - a. Fire door assemblies, in compliance with NFPA 80.
 - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:
 - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
 - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
2. Smoke and Draft Control Door Assemblies:
 - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105

- b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
- 3. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- 4. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

- 1. Keying Conference
 - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
- 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
- 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) Schlage ND Series: 10 years
 - 2) Exit Devices
 - a) Von Duprin: 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - 4) Automatic Operators
 - a) LCN: 2 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
 - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

- A. Fabrication
 - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
 - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
 - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
 - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.
- C. Cable and Connectors:
 - 1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
 - 2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
 - 3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. Hager BB1191/1279 series
 - b. McKinney TB series
 - c. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
 - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
 - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
 - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
 - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
 - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins
9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

2.04 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ND series
2. Acceptable Manufacturers and Products:
 - a. EXISTING OWNER STANDARD

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.

2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
 - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
 - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
 - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
3. Cylinders: Refer to "KEYING" article, herein.
4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
 - a. Lever Design: RHODES

2.05 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
 - a. EXISTING OWNER STANDARD

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non-fire-rated openings.

12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.06 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 6000 Series
2. Acceptable Manufacturers and Products:
 - a. EXISTING OWNER STANDARD

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.07 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage Everest 29 S
2. Acceptable Manufacturers and Products:
 - a. Owner Preference

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
 - a. Patented Open: cylinder with permanent core with open keyway.
 - b. Patented Open: cylinder with interchangeable core with open keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.08 KEYING

A. Scheduled System:

1. New factory registered system:
 - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Temporary Construction Cylinder Keying.
 - 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
 - a) Split Key or Lost Ball Construction Keying System.
 - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
 - c) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will void operation of temporary construction keys.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Permanent Control Keys: 3.
 - 2) Master Keys: 6.
 - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
 - 4) Key Blanks: Quantity as determined in the keying meeting.

2.09 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Telkee
2. Acceptable Manufacturers:
 - a. HPC
 - b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.10 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4040XP series
2. Acceptable Manufacturers and Products:
 - a. EXISTING OWNER STANDARD

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certified closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117 or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

2.11 ELECTROMECHANICAL AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN Senior Swing
2. Acceptable Manufacturers and Products:
 - a. Besam Swingmaster MP
 - b. Horton 4000LE series
 - c. Stanley Access Technologies M-Force

B. Requirements:

1. Provide low energy automatic operator units that are electromechanical design complying with ANSI/BHMA A156.19.
 - a. Opening: Powered by DC motor working through reduction gears.
 - b. Closing: Spring force.
 - c. Manual, hydraulic, or chain drive closers: Not permitted.
 - d. Operation: Motor is off when door is in closing mode. Door can be manually operated with power on or off without damage to operator. Provide variable adjustments, including opening and closing speed adjustment.
 - e. Cover: Aluminum.
2. Provide units with manual off/auto/hold-open switch, push and go function to activate power operator, vestibule interface delay, electric lock delay, hold-open delay adjustable from 1 to 32 seconds, and logic terminal to interface with accessories, mats, and sensors.
3. Provide drop plates, brackets, and adapters for arms as required to suit details.
4. Provide motion sensors and/or actuator switches, and receivers for operation as specified. Provide weather-resistant actuators at exterior applications.
5. Provide key switches, with LED's, recommended and approved by manufacturer of automatic operator as required for function as described in operation description of hardware sets. Cylinders: Refer to "KEYING" article, herein.
6. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.

2.12 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:

- a. Trimco
- b. Rockwood

B. Requirements:

- 1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
- 2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
- 3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturers:
 - a. Glynn-Johnson
- 2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent

B. Requirements:

- 1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.14 DOOR STOPS AND HOLDERS

A. Manufacturers:

- 1. Scheduled Manufacturer:
 - a. Ives
- 2. Acceptable Manufacturers:
 - a. Trimco
 - b. Rockwood

B. Provide door stops at each door leaf:

- 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
- 2. Where a wall stop cannot be used, provide universal floor stops.
- 3. Where wall or floor stop cannot be used, provide overhead stop.
- 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Zero International
 2. Acceptable Manufacturers:
 - a. National Guard
 - b. Pemko
- B. Requirements:
1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.16 SILENCERS

- A. Manufacturers:
1. Scheduled Manufacturer:
 - a. Ives
 2. Acceptable Manufacturers:
 - a. Rockwood
 - b. Trimco
- B. Requirements:
1. Provide "push-in" type silencers for hollow metal or wood frames.
 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 3. Omit where gasketing is specified.

2.17 MAGNETIC HOLDERS

- A. Manufacturers:
1. Scheduled Manufacturer:
 - a. LCN
 2. Acceptable Manufacturers:
 - a. Rixson
 - b. Sargent
- B. Requirements:

1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of holding force. Coordinate projection of holder and armature with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Connect magnetic holders on fire-rated doors into the fire control panel for fail-safe operation.

2.18 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Schlage
2. Acceptable Manufacturers:
 - a. GE-Interlogix

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.19 FINISHES

A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, 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. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. 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. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/ HOLDERS: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 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. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
 - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.

- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

Abbreviation	Name
GLY	Glynn-Johnson Corp
IVE	H.B. Ives
LCN	LCN Commercial Division
LOC	Locknetics Security Engineering
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc










ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

118933 OPT0388635 Version 2

HW SET: 01

For use on Door #(s):
 110A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	98-L-NL-06		626	VON
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC		⚡ 630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28		⚡	
1	EA	DESK MOUNT BUTTON	660-PB		⚡ 628	SCE
1	EA	DOOR CONTACT	679-05HM		⚡ BLK	SCE
1	EA	REX.	BY DIVISION 28		⚡	
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28		⚡	

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.
 ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER
 OPENS DOOR TO ENTER.
 ENTRY ALSO GRANTED BY REMOTE RELEASE BUTTON AT RECEPTION
 DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.
 EGRESS AT ALL TIMES BY EXIT DEVICE.









ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: 02

For use on Door #(s):

120A 160A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	98-L-NL-06		626	VON
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.

DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.








EGRESS AT ALL TIMES BY EXIT DEVICE.

HW SET: 03

For use on Door #(s):

144A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	98-L-NL-06		626	VON
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP CUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.

DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.









EGRESS AT ALL TIMES BY EXIT DEVICE.

ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: 04

For use on Door #(s):
 102A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.

DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.

EGRESS AT ALL TIMES BY INSIDE LEVER.









LOCK FUNCTION ALLOWS DOOR TO BE MANUALLY UNLOCKED FOR PUBLIC OPERATING HOURS

ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: 05

For use on Door #(s):
 162B

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP HEDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.

DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.

EGRESS AT ALL TIMES BY INSIDE LEVER

LOCK FUNCTION ALLOWS DOOR TO BE MANUALLY UNLOCKED FOR PUBLIC OPERATING HOURS

DOOR CLOSER HAS MANUAL HOLD OPEN ARM









ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: 06

For use on Door #(s):

124A 132C 161A 162A 163A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		

OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.

ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.

DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.










EGRESS AT ALL TIMES BY INSIDE LEVER

ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: 07

For use on Door #(s):
 140A

Each to have:

4	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	DUTCH DOOR BOLT	054		626	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE 12/16/24/28 VAC/VDC	 ⚡	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
2	EA	MAGNET	SEM7850 12V/24V/120V	 ⚡	689	LCN
3	EA	SILENCER	SR64		GRY	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28	⚡		
1	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	REX.	BY DIVISION 28	⚡		
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28	⚡		





OPERATION:

DOOR NORMALLY CLOSED AND LOCKED.
 ENTRY BY CREDENTIAL READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER
 OPENS DOOR TO ENTER.
 DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.
 EGRESS AT ALL TIMES BY INSIDE LEVER
 LOCK FUNCTION ALLOWS DOOR TO BE MANUALLY UNLOCKED
 WALL MAGNET TO HOLD TOP LEAF OPEN

HW SET: 08

For use on Door #(s):
 151A





Each to have:

3	EA	HINGE	5BB1 5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	OH STOP & HOLDER	90H		630	GLY
3	EA	SILENCER	SR64		GRY	IVE

HW SET: 09

For use on Door #(s):
122A

Each to have:





3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HW SET: 10

For use on Door #(s):

105A	107A	109A	111A	113A	115A
117A	126A	127A	134A	135A	145A

Each to have:







3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HW SET: 11

For use on Door #(s):

119A	121A	157A
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Each to have:







3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP HW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HW SET: 12

For use on Door #(s):

132A	132B	133A
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Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE







ELMORE COUNTY
PUBLIC SERVICES BUILDING 1
MOUNTAIN HOME, ID

HW SET: 13

For use on Door #(s):

149A 149B

Each to have:







3	EA	HINGE	5BB1 5 X 4.5 NRP		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

HW SET: 14

For use on Door #(s):

103A 104A 129A 130A

Each to have:






3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS439		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

HW SET: 15

For use on Door #(s):

153A 155A

Each to have:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	ND40S RHO OS-OCC		626	SCH
1	EA	SURFACE CLOSER	4040XP CUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER




ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: EX01

For use on Door #(s):

E120B E150B

Each to have:

1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ'D)		626	SCH
1	EA	SURF. AUTO OPERATOR	9542 MS AS REQ (120/240 VAC)		✓ ANCL	LCN
					R	
2	EA	WIRELESS ACTUATOR	8310-3857TW		630	LCN
		PKG.				
	EA	NOTE	BALANCE OF EXISTING			
			HARDWARE TO REMAIN			



DOOR NORMALLY CLOSED AND LOCKED
 ENTRY BY CREDENTIAL READER TO RELEASE ELECTRIC STRIKE
 EXTERIOR ACTUATOR IS ACTIVE WHEN DOOR IS UNLOCKED
 EGRESS AT ALL TIMES BY PANIC HARDWARE
 INSIDE ACTUATOR WILL RELEASE ELCTRIC STRIKE AND CYCLE THE OPERATOR

HW SET: EX02

For use on Door #(s):

E110B

Each to have:









1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ'D)		626	SCH
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC		✓ 630	VON
1	EA	CREDENTIAL READER.	BY DIVISION 28		✓	
1	EA	DOOR CONTACT.	BY DIVISION 28		✓	
1	EA	REX.	BY DIVISION 28		✓	
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28		✓	

ELMORE COUNTY
 PUBLIC SERVICES BUILDING 1
 MOUNTAIN HOME, ID

HW SET: EX03

For use on Door #(s):
 E141B

Each to have:




3	EA	HINGE	5BB1 4.5 X 4.5 NRP		630	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	NO CUT ELECTRIC STRIKE	NC450 12/24 VDC		630	LOC
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	CREDENTIAL READER.	BY DIVISION 28			
1	EA	DOOR CONTACT.	BY DIVISION 28			
1	EA	REX.	BY DIVISION 28			
1	EA	LOW VOLTAGE POWER.	BY DIVISION 28			
	EA	NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

FIELD VERIFY EXISTING FRAME AND DOOR PREPS FOR COMPATBILITY WITH NEW HARDWARE OPERATION:
 DOOR NORMALLY CLOSED AND LOCKED.
 ENTRY BY CARD READER TO TEMPORARILY RELEASE THE ELECTRIC STRIKE, USER OPENS DOOR TO ENTER.
 DOOR POSITION IS MONITORED THROUGH ACCESS CONTROL SYSTEM.
 EGRESS AT ALL TIMES BY INSIDE LEVER.

HW SET: EX04

For use on Door #(s):
 E141A E141C E141D

Each to have:


3	EA	HINGE	5BB1 5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
3	EA	SILENCER	SR64		GRY	IVE
	EA	NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

FIELD VERIFY EXISTING FRAME AND DOOR PREPS FOR COMPATBILITY WITH NEW HARDWARE

HW SET: EX05

For use on Door #(s):
 E100A E131A

Each to have:

1	EA	MORTISE CYLINDER	20-001 (CAM AS REQ'D)		626	SCH
	EA	NOTE	BALANCE OF EXISTING HARDWARE TO REMAIN			

ELMORE COUNTY
PUBLIC SERVICES BUILDING 1
MOUNTAIN HOME, ID

HW SET: R1

For use on Door #(s):
E141E

Each to have:

EA NOTE

ALL HARDWARE IS EXSITING

END OF SECTION 087100

SECTION 088700
GLAZING SURFACE FILMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface applied safety and security and privacy films for interior glass or interior face of exterior glass.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate Work of this Section with other Sections for proper time and sequence to avoid construction delays.

B. Preinstallation Meetings: Conduct meeting at Project site.

1. Review and finalize construction schedule, Project requirements, substrate conditions, and coordination with other building subtrades, and to review manufacturer's installation instructions and manufacturer's warranty requirements.
2. Review temporary protection requirements for glazing during and after installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each product.

1.4 INFORMATION SUBMITTALS

A. Test and Evaluation Reports:

1. Certified test reports showing compliance with specified performance characteristics and physical properties.
2. Manufacturer's Instructions: Manufacturer's storage, handling, and installation instructions.

B. Source Quality Control: Documentation verifying that components and materials specified in this Section are from single manufacturer.

C. Manufacturer's Reports: Manufacturer's field reports specified.

D. Qualification Statements:

1. Submit letter of verification for Manufacturer's Qualifications.
2. Submit letter of verification for Installer's Qualifications.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Manufacturer's instructions detailing care and maintenance of security and safety film.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer with 5 years of experience manufacturing components similar to or exceeding requirements of Project, sufficient capacity to produce and deliver required materials without causing delay in Work, and is capable of providing field service representation during construction.

- B. Installer Qualifications: Acceptable to manufacturer, experienced in type of work of this Section, and has specialized in installation of work similar to that required for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer shall ensure proper quality control during production, shipping, and inventory, clearly identify and label each film core with product designation and run number.
- B. Deliver materials to Project site with manufacturer's labels intact and legible.
- C. Store materials protected from exposure to harmful weather conditions and at temperatures recommended by manufacturer.
- D. Store rolls of film flat on cross supports. Do not stand rolls of film on end.
- E. Packaging Waste Management:
 - 1. Remove packaging materials from site and dispose of at appropriate recycling facilities.
 - 2. Fold metal and plastic banding, flatten and place in designated area for recycling.
 - 3. Remove pallets from site and return to supplier or manufacturer.

1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace window films that fail in materials or workmanship within specified warranty period.
 - 1. Repair defects from faulty materials or workmanship developed during guarantee period, or replace with new materials, at no expense to Owner.
 - 2. Failures include cracking, crazing, delaminating, peeling, or discoloration.
 - 3. Warranty covers the following:
 - a. Film will maintain solar reflective properties.
 - b. Glass failure due to thermal shock fracture of glass provided film is applied to recommended types of glass and failure occurs within 60 months from start of application. Glass failures shall be reviewed by film manufacturer prior to replacement.
 - 4. Warranty Period: Minimum of 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLAZING SURFACE FILMS, GENERAL

- A. Provide uniform film, without noticeable pin holes, streaks, thin spots, scratches, banding, or other optical defects. Variation in total transmission across width, at any portion along length, shall not exceed two percent over average. Provide film with no evidence of coating voids.
- B. Use: Provide surface films that are suitable for interior applications unless indicated otherwise.

2.2 DECORATIVE FILMS

- A. Decorative (Privacy) Film. Translucent, dimensionally stable, cast vinyl film with releasable protective backing, with pressure-sensitive, clear adhesive back for adhering to glass and metal.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Solyx SXGF-0097 Deep Etch by Decorative Films, LLC or approved substitution from one of the following manufacturers:
 - a. 3M Commercial Solutions.
 - b. Aegis Films.
 - c. Avery Dennison, Graphics.
 - d. Decorative Films, LLC: Solyx SimGlas Decorative Films.
 - e. Eastman Chemical Company.
 - f. Eykon Design Resources.

- g. Film Technologies International, Inc.
 - h. Glass Apps, LLC.
 - i. Johnson Window Films.
 - j. LG Hausys, Ltd.
 - k. Lumar.
 - l. Madico.
 - m. Orafol Americas.
 - n. Solar Gard.
 - o. Solutia, Inc., a subsidiary of Eastman Chemical Company.
- 2. Thickness: 3.0 mil.
 - 3. Flammability: Self-Extinguishing.
 - 4. Durability: Vertical Exposure for unprinted film: 10 years.
 - 5. Colors: As selected by the Architect from manufacturer's full product line.

2.3 SAFETY AND SECURITY WINDOW FILMS

- A. Security and Safety Glazing Film: Optically clear, tear-resistant, penetration-resistant, and abrasion-resistant polyester film with pressure-sensitive adhesive, for applying to inside face of interior lite to provide forced-entry and blast-resistance.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Product by 3M Company or approved substitution from one of the following manufacturers:
 - a. 3M Commercial Solutions: 3M Safety S80 (SH8CLARL) .
 - b. Aegis Films: AF 8.
 - c. Clear Armor LLC: Tru Armor SL 9.
 - d. CPFilms Inc.: LLumar SCLSRPS8 Safety-and-Security Film.
 - e. Huper Optik USA: Clear Shield 8 mil.
 - f. Johnson Window Films: SEC 08.
 - g. Madico Window Films: CL-800.
 - h. Scorpion Window Film: ASFPS8.
 - i. ShatterGARD Glass Protection Films, Inc.: BurglarGARD.
 - j. Solar Gard: 11 Mil Clear Armorcoat.
 - 3. Performance Criteria: Based on film applied to 1/4 inch thick clear glass and complying with the following requirements:
 - a. Blast Resistance: Performance Condition 2 according to GSA-TS01.
 - b. Forced-Entry Resistance: Class II according to ASTM F 1233.
 - c. Tensile Strength: ASTM D882; 25, 000 psi.
 - d. Break Strength: ASTM D882; 200 psi.
 - e. UV Rejection: 99 percent.
 - f. Visible Light Transmittance: 87 percent.
 - g. Provide safety glazing labeling.
 - h. Visible Light Transmission: 15 percent.
 - i. Visible Reflection:
 - 1) Exterior: 38 percent.
 - 2) Interior: 11 percent.
 - j. Ultraviolet Transmission: Less than one percent.
 - k. Solar Heat Gain Coefficient at 90 Degrees (Normal Incidence): 0.28.
 - 4. Thickness: Minimum 8 mils, or as required to meet Performance Criteria.
 - 5. Colors: Clear.

2.4 ACCESSORIES

- A. Film Slip Solution: Unless film manufacturer recommends other methods or products for its film slip solution, make solution with one capful of Johnson Baby Shampoo or Joy Dishwashing Liquid to one gallon of water.
- B. Tools: Use tools recommended by film manufacturer, including polyplastic bladed squeegees, five-way tools, cutting tools, and razor blades.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine glass surfaces to receive film and verify that they are free from defects and imperfections, which will affect final appearance. Correct and note such deficiencies to Architect prior to commencing film application.

3.2 PREPARATION

- A. Use protective tarps and drop cloths to cover interior finishes near window.
- B. Turn off or cover heating and air conditioning ventilation ducts.
- C. Clean window and window framing thoroughly with cleaning solution consisting of 90 percent water and 10 percent ammonia. Blade inside surface of window glass with industrial razors to insure removal of foreign contaminants.
 - 1. Tape and seal cracked and deteriorating window sealant.
- D. Place towel or other absorbent material on window sill or sash to absorb moisture accumulation generated by film application.
- E. Thoroughly rinse glass from top to bottom with pressure spray tank.
- F. Squeegee entire glass surface.
- G. Dry glass edges and window frames using a lint-free towel.

3.3 APPLICATION

- A. Install window film per manufacturer's written instructions.
 - 1. Cut film edges neatly and square at a uniform distance of 1/8 inch to 1/16 inch of window sealant. Use new blade tips after three to four cuts.
 - 2. Spray film slip solution on window glass and adhesive to facilitate proper positioning of film.
 - 3. Apply film to glass and lightly spray film with slip solution.
 - 4. Squeegee to remove water.
 - 5. Spray slip solution to film and squeegee a second time.
 - 6. Bump film edge with lint-free towel wrapped around edge of a five-way tool.
 - 7. Wipe frame edge dry
 - 8. Inspect installation to insure proper application.
 - 9. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.4 REPAIR

- A. Visual Inspection: Per IWFA – Visual Quality Standard for Applied Window Film to determine optical quality, edge gap thickness control, and film splicing and seaming quality.

- B. Remove and replace film that continues to show blisters, bubbles, tears, scratches, edge defects, or vision distortion in film when viewed under natural daylight from 6 feet minimum after 30 day period.

3.5 CLEANING

- A. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.
- B. After installation, remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

END OF SECTION 088700

SECTION 092900

GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gypsum board panels.
 - 2. Tile backing panels.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples for Verification: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12 inch long length for each trim accessory indicated.
 - 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.
- B. Mockups: Build mockups in compliance with Section 014339 – Mockups to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups a minimum of 100 sq. ft. in surface area for each level of gypsum board finish that will be exposed to view.
 - 2. Build mockups a minimum of 32 sq. ft. in surface area for each texture finish indicated.
 - 3. Apply or install final decoration indicated, including painting, on exposed surfaces for review of mockups.
 - 4. Simulate finished lighting conditions for review of mockups.
 - 5. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

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 supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, 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, or mold damaged.
 - 1. Wet or moisture damaged panels will be discolored, sagging, or irregular shaped.
 - 2. Mold damaged panels will have fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated per ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated per ASTM E90 and classified per ASTM E413 by an independent testing agency.
- C. Verify ceiling and wall materials comply with requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 GYPSUM BOARD, GENERAL

- A. Recycled Content: Postconsumer recycled content plus 1/2 of preconsumer recycled content not less than 20 percent.
- B. Size: Provide in 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 Board, Type X: ASTM C1396; surfaced with 100 percent recycled content paper on front, back, and long edges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Gypsum, Inc.: CertainTeed Type X.
 - b. Georgia-Pacific Gypsum LLC: ToughRock Fireguard X.
 - c. National Gypsum Company: Gold Bond Brand Fire-Shield.
 - d. USG Corporation: USG Sheetrock Brand Firecode X or EcoSmart Panels Firecode X.
 - e. Approved substitution.
 - 2. Thickness: 5/8 inch.
 - 3. Edges: Tapered and featured (rounded or beveled) for prefilling.
 - 4. Applications: Typical at walls, ceilings, and other gypsum board locations unless other types are indicated.
 - 5. Applications: Typical at walls, ceilings, and other gypsum board locations unless other types are indicated.
- B. Gypsum Board, Lightweight, Type X: ASTM C1396; surfaced with 100 percent recycled content paper on front, back, and long edges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - b. Georgia-Pacific Gypsum LLC: ToughRock Lite-Weight Fire-Rated Gypsum Board.
 - c. National Gypsum Company: Gold Bond High Strength Fire-Shield 60 Gypsum Board.
 - d. USG Corporation: USG Sheetrock Brand EcoSmart Panels Firecode X.
 - e. Approved substitution.
 - 2. Thickness: 5/8 inch.
 - 3. Edges: Tapered and featured (rounded or beveled) for prefilling.
 - 4. Surface-Burning Characteristics: Comply with ASTM E84; testing by qualified testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 25 or less.
 - 5. Applications: Typical at walls, ceilings, and other gypsum board locations unless other types are indicated.
- C. Abuse-Resistant Gypsum Board: ASTM C1396 gypsum board, tested according to ASTM C1629.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Gypsum, Inc.: CertainTeed Extreme Abuse Resistant Type X.
 - b. Georgia-Pacific Gypsum LLC: ToughRock Abuse-Resistant Gypsum Board.
 - c. National Gypsum Company: Hi-Abuse XP Gypsum Board.
 - d. USG Corporation: SheetRock Brand AR Firecode X [**Gypsum**] Panels.
 - e. Approved substitution.
 2. Core: 5/8 inch, Type X.
 3. Surface Abrasion: Meets or exceeds Level 1 requirements.
 4. Surface Indentation: Meets or exceeds Level 1 requirements.
 5. Single-Drop Soft-Body Impact: Meets or exceeds Level 1 requirements.
 6. Long Edges: Tapered.
 7. Mold Resistance: Score of 10 as rated according to ASTM D3273.
 8. Applications: Corridor walls and where indicated.
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C1396; with moisture- and mold-resistant core and paper surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Gypsum, Inc.: CertainTeed M2Tech Type X Gypsum Board.
 - b. Georgia-Pacific Gypsum LLC: ToughRock Fireguard X Mold-Guard.
 - c. National Gypsum Company: Gold Bond XP Fire-Shield Gypsum Board.
 - d. USG Corporation: USG Sheetrock Brand Mold Tough Firecode X Panels.
 - e. Approved substitution.
 2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C1396; manufactured to have increased fire-resistive capability over Type X gypsum board.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Gypsum, Inc.: CertainTeed Type C.
 - b. Georgia-Pacific Gypsum LLC: ToughRock Fireguard C.
 - c. National Gypsum Company: Gold Bond BRAND Fire-Shield C.
 - d. USG Corporation: USG Sheetrock Brand Firecode C.
 - e. Approved substitution.
 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 3. Long Edges: Tapered.
- B. Glass-Mat Interior Gypsum Board: ASTM C1658. With fiberglass mat laminated to both sides. Specifically designed for interior use.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Georgia-Pacific Gypsum LLC: DensArmour Plus.
 - b. National Gypsum Company: eXP Interior Extreme.
 - c. USG Corporation: USG Sheetrock Brand Glass-Mat Panels Mold Tough Firecode X.
 - d. Approved substitution.
 2. Core: 5/8 inch, Type X.
 3. Long Edges: Tapered.
 4. Mold Resistance: ASTM D3273, score of 10 as rated per ASTM D3274.
 5. Applications: Interior side of gypsum board shaft wall assemblies.

2.5 TILE BACKING PANELS

- A. Cementitious Backer Units: ASTM C1288 or ASTM C1325, Type A, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. C-Cure: C-Cure Board 990.
 - b. Custom Building Products: Wonderboard Lite Backerboard.
 - c. FinPan, Inc.: ProTECH or Util-A-Crete Concrete Backer Board.
 - d. James Hardie Building Products, Inc.: Hardiebacker 500 Cement Board.
 - e. National Gypsum Company: Permabase Cement Board.
 - f. USG Corporation: DUROCK Cement Board.
 - g. Approved substitution.
2. Thickness: 1/2 inch unless indicated otherwise.
 3. Maximum framing spacing is 16 inches on center.
 4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
 2. Shapes: As required for conditions indicated on Drawings.
- B. Expansion (Control) Joints: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet control joint with 1/2 to 3/4 inch grounds for drywall finishes. Staple or screw grounds to panel face.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Alabama Metal Industries Corporation (AMICO).
 - b. Armstrong World Industries, Inc.
 - c. Fry Reglet Corporation.
 - d. Gordon Interior Specialties Division, Gordon, Inc.
 - e. USG Corporation.
 - f. Approved substitution.
 2. Application: Interior gypsum board walls and ceilings.
 3. Where fire and sound control joints are indicated, provide fire rated seal behind control joint.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flannery, Inc.
 - b. Fry Reglet Corporation.
 - c. Gordon Interior Specialties Division, Gordon, Inc.
 - d. Pittcon Industries.
 - e. Approved substitution.
 2. Aluminum: Alloy and temper with not less than strength and durability properties of ASTM B221, Alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
 4. REVEAL-1: F-type reveal molding.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Fry Reglet: DRMF-625-75.
 - 2) Approved substitution.
 - b. Size: 3/4 inch wide by 5/8 inch deep.
 5. REVEAL-2: U-type reveal molding.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Fry Reglet: DRM-50-50.
 - 2) Approved substitution.

- b. Size: 1/2 inch wide by 1/2 inch deep.
- 6. REVEAL-3: L-type reveal molding.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Fry Reglet: DRML-1250.
 - 2) Approved substitution.
 - b. Size: 1-1/4 inch wide by 7/8 inch joint compound leg.
- 7. REVEAL-4: U-type reveal molding.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Gordon, Inc.: Final Forms I, Series 500 Wall Reveal.
 - 2) Approved substitution.
 - b. Size: 1/8 inch wide by 7/16 inch deep.
- 8. REVEAL-5: Z-type reveal molding.
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - 1) Gordon, Inc.: Final Forms I, Series 300 Wall Reveal.
 - 2) Approved substitution.
 - b. Size: 1 inch wide by 1 inch deep.

2.7 JOINT TREATMENT MATERIALS

- A. Comply with ASTM C475.
- 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, beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: or embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use 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. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Verify adhesives have a VOC content of 50 g/L or less.
 - 1. Verify adhesives comply with 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. Steel Drill Screws: ASTM C1002, unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by cementitious panel manufacturer.

2.9 SOUND ATTENUATION

- A. Acoustical Joint Sealant: Refer to Section 079219 – Acoustical Joint Sealants.
- B. Sound Attenuation Insulation: Refer to Section 098100 – Acoustic Insulation for the following:

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- 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.
- D. Evaluation and Assessment:
 1. After installation of sound control components and before installation of gypsum board, allow access to Architect's [Owner's] acoustical consultant to verify installation of sound control components.

3.2 INSTALLATION AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize 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 1 framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 square feet in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4 to 3/8 inch wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4 to 1/2 inch wide spaces at these locations, and trim edges with edge trim

where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 INSTALLATION OF STC-RATED ASSEMBLIES

- A. Provide materials as required by gypsum panel system manufacturers to achieve laboratory Sound Transmission Class (STC) ratings indicated.
- B. Install sound attenuation insulation before installing gypsum panels, unless blankets are readily installed after panels have been installed on 1 side.
- C. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- D. Do not install gypsum panel layers continuous between 2 adjacent rooms.
- E. STC-Rated Assemblies: Seal construction according to requirements specified in Section 079219.

3.4 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Typical at walls, ceilings, and other gypsum board locations unless other types are indicated.
 - 2. Abuse-Resistant Type: Corridor walls and where indicated.
 - 3. Moisture- and Mold-Resistant Type: Walls subject to moisture exposure such as kitchens, toilets, behind drinking fountains, utility areas, and as indicated on Drawings.
 - 4. Type C: As indicated on Drawings where required for specific fire-resistance-rated assembly indicated.
 - 5. Glass-Mat Interior Type: Interior side of gypsum board shaft wall assemblies.
 - 6. Cementitious Tile Backer Type: At wet areas as indicated on Drawings.
 - 7. Skim-Coated 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-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

1. 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.
2. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws; fasten face layers with adhesive and supplementary fasteners if required to comply with fire-rated assembly design.

3.5 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.1, at showers, tubs, and where indicated, and locations indicated to receive tile unless indicated otherwise.
 1. Install cementitious backer unit as backing for first 12 inches above finish floor behind tile, fiberglass reinforced plastic panels, and other similar wet locations where moisture resistant gypsum board is used. Install moisture resistant gypsum board on remainder of wall.
- B. panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLATION OF TRIM ACCESSORIES

- A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim per manufacturer's written instructions.
- B. Control (Expansion) Joints: Install control joints per ASTM C840, and in specific locations approved by Architect for visual effect.
 1. Minimum Control Joint Spacing: 30 feet on center each way.
 2. Minimum Joint Spacing Between Panels: 1/4 inch.
- C. Interior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 2. Bullnose Bead: Use at outside corners or where indicated.
 3. LC-Bead: Use at exposed panel edges.
 4. L-Bead: Use where indicated.
 5. U-Bead: Use at exposed panel edges or where indicated.
 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
 1. Cornerbead: Use at outside corners.
 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

- A. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C840, for locations indicated:
1. Leve 0: Where no taping, finishing, or accessories is required.
 - a. Use above suspended ceilings and within other concealed spaces that are not fire rated, sound rated, sound or smoke controlled, or does not serves as an air plenum.
 2. Level 1: Above suspended ceilings and within other concealed spaces where gypsum board assembly is fire rated, sound rated, sound or smoke controlled or that serve as an air plenum, and at exposed walls in TI spaces that do not receive finishes as part of this Project.
 3. Level 2: Provide Level 2 finish at the following conditions:
 - a. Where indicated for tile, adhered acoustical panels, and wood paneling.
 - b. Utility areas and behind cabinetry.
 4. Level 3: Provide Level 3 finish at the following condition:
 - a. Ceilings indicated to receive spray texture finish.
 5. Level 4: Provide Level 4 finish at the following conditions:
 - a. Where indicated as exposed to view and flat finish coat, unless otherwise indicated.
 - b. Where indicated for light-textured-finish wall covering and heavy wall covering.
 6. Leve 5: Provide Level 5 finish at the following condition:
 - a. Where indicated for semi-gloss or gloss finish coats.
 7. Primer: Refer to Section 099000 –Painting and Coating.
- E. Cementitious Tile Backer Units: Finish according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before installing gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Notify Architect 7 days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
- B. Installation of ceiling support framing.

3.9 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 construction period.
- C. Remove and replace panels that are wet, moisture damaged, or mold damaged.

3.10 IDENTIFICATION OF FIRE AND SMOKE PARTITION

- A. Provide permanently applied lettering on partitions, either labels or paint with stencils, above suspended ceilings, to identify locations of fire and smoke walls.
1. Lettering Size: Minimum of 1 inch high and 10 feet on center.
 2. Lettering Identification: On appropriate partitions, provide the following lettering as identified on Code Analysis Drawings:
 - a. SMOKE BARRIER – 1 HOUR FIRE RATING

- b. FIRE SEPARATION & SMOKE BARRIER – 2 HOUR FIRE RATING
- c. FIRE WALL – 2 HOUR FIRE RATING
- d. FIRE WALL – 1 HOUR FIRE RATING

END OF SECTION 092900

SECTION 093013

CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tile for floors and walls.
2. Waterproof and crack isolation membrane.
3. Uncoupling membrane.
4. Setting and grouting materials.
5. Thresholds.
6. Transition strips.
7. Tile access panel system.

B. Related Requirements:

1. Section 134816 – Manufactured Sound Control Components, for sound control underlayment.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct meeting at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

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 for each color and finish required.
3. Metal edge strips in 6 inch lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Product Test Reports: For each tile-setting, grouting, and certified tile product.

1.5 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, but not less than 1 full carton of each type of unit.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated, but not less than 1 package.
3. Floor Sealer: Minimum of 1 gallon in manufacturer's unopened, labeled container. Include instructions for use.
4. Cleaning Agent: Minimum of 5 gallons in unopened container, clearly labeled with manufacturer's logo and instructions for use.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing tile installations and finishing comparable in scope of this Project, with minimum 3 years of documented experience.
 1. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors, membranes, shower receptors, and large format tile.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor and wall tile installation in size and locations as directed by Architect.
 2. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1.7 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.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at 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 one 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 one manufacturer and each aggregate from one source or producer.
 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof and crack isolation membranes, 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 for each product:
 - 1. Thresholds.
 - 2. Waterproof and crack isolation membrane.
 - 3. Cementitious backer units.
 - 4. Transition edge strips.

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 unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Products: See Interior Finish Legend on Drawings for selected tile products.
- B. THRESHOLDS
- C. Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

2.4 TILE BACKING PANELS

- A. Tile Backer Units: Specified in Section 092900 – Gypsum Board.

2.5 WATERPROOF AND CRACK ISOLATION MEMBRANES

- A. Manufacturer's standard products that comply with ANSI A118.10 and ANSI A118.12; and are recommended by manufacturer for applications indicated.
 - 1. Provide reinforcement and accessories recommended by manufacturer.
- B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer that complies with ANSI A118.10 as waterproof membrane, and ANSI A118.12 as crack isolation membrane.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: Ardex S 1-K.
 - b. Custom Building Products: RedGard Waterproofing and Crack Prevention Membrane.
 - c. Laticrete International, Inc.: Hydro Ban or Hydro Barrier.
 - d. MAPEI Corporation: Mapelastic AquaDefense.
 - e. Parex USA, Inc.: Merkrete Hydro-Guard 2000.
 - 2. Crack Resistance: In-plane cracks up to 1/8 inch wide.
 - 3. Thickness: Maximum 0.020 inch.
- C. Fluid-Applied Membrane, Fabric-Reinforced: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement that complies with ANSI A118.10 as waterproof membrane, and ANSI A118.12 as crack isolation membrane.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: Ardex S 1-K with Ardex SK Mesh.
 - b. Custom Building Products: 9240 Waterproofing and Anti-Fracture Membrane.
 - c. Laticrete International, Inc.: 9235 Waterproof Membrane.
 - d. MAPEI Corporation: Mapelastix AquaDefense with MAPEI Fiberglass Mesh.
 - e. Parex USA, Inc.: Merkrete Hydro-Guard 2000 with Merkrete Fabric Type 2.
 - f. Summitville Tiles, Inc.: S-9000.
2. Crack Resistance: In-plane cracks up to 1/8 inch wide.
3. Thickness: Maximum 0.020 inch.

2.6 UNCOUPLING MEMBRANE

- A. Uncoupling Membrane: Corrugated, high-density polyethylene membrane with a grid structure of square or other shaped cavities, each cut back in a dovetail configuration, and a polypropylene anchoring fleece laminated to its underside.
1. Products: Subject to compliance with requirements, provide the following:
 - a. ARDEX Americas: Ardex UI 740 Flexbone.
 - b. Custom Building Products: RedGard Uncoupling Mat.
 - c. Laticrete International, Inc.: Laticrete Strata_Mat.
 - d. Schluter Systems L.P.: DITRA.
 - e. Approved substitution.
 2. Nominal Thickness: Nominal 0.125 inch.
 3. Description: Allows for separation between membrane and mortar adhering tile to membrane when subjected to excessive substrate movement.
 4. Application: Installation of large format tile where waterproofing membrane is indicated.

2.7 SETTING MATERIALS

- A. Modified Dry-Set Mortar for Thin Set and Medium-Bed Applications: ANSI A118.4.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: Ardex X 5.
 - b. Custom Building Products: ProLite Premium Large Format Tile Mortar.
 - c. Laticrete International, Inc.: 4-XLT or LHT.
 - d. MAPEI Corporation: Ultraflex LFT.
 - e. Parex USA, Inc.: Merkrete 720 Dustless LHT Mortar.
 - f. Approved substitution.
 2. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
 3. Applications:
 - a. Thin Set Type: 3/16 inch thick application for tile with no edge greater than 15 inches.
 - b. Medium Set Type: 1/2 to 5/8 inch thick application for tile with at least 1 edge greater than 15 inches.
 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.
- B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX S 28 MICROTEC.
 - b. Custom Building Products: Complete Contact Fortified Mortar.
 - c. Laticrete International, Inc.: 254 Platinum.
 - d. MAPEI Corporation: Ultraflex 3.
 - e. Approved substitution.
 2. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site

3. Application: For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.15.
- C. EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar (Thinset): ANSI A118.11.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX X 77 MICROTEC Fiber Reinforced Tile and Stone Mortar.
 - 1) setting glass tile in non-submerged applications
 - 2) Balconies, terraces and building facades great deal of movement due to temperature changes, for vertical or horizontal applications
 - b. Custom Building Products: FlexBond Premium Crack Prevention Thin-set Mortar.
 - c. Laticrete International, Inc.: 257 Titanium.
 - d. MAPEI Corporation: Ultraflex RX.
 - e. Parex USA, Inc.: Merkrete 750 RS Thin Set.
 - f. Approved substitution.
 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
- D. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX WA High Performance, 100% Solids Epoxy Grout and Adhesive.
 - b. Custom Building Products: EBM-Lite Premium Epoxy Bonding Mortar — 100% Solids.
 - c. Laticrete International, Inc.: Spectralock Pro Premium Grout.
 - d. MAPEI Corporation: Kerapoxy.
 - e. Parex USA, Inc.: Merkrete Pro Epoxy.
 - f. Approved substitution.
 2. For moisture-sensitive natural stone, cement or agglomerate tile
 3. Verify adhesives have a VOC content of 65 g/L or less.
 4. Verify adhesive complies with testing and product requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F respectively, and certified by manufacturer for intended use.

2.8 GROUT MATERIALS

- A. Standard Cement Grout: ANSI A118.6.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX FH Sanded Floor and Wall Grout.
 - b. Custom Building Products: Polyblend Sanded Grout.
 - c. Laticrete International, Inc.: 1500 Sanded Grout.
 - d. MAPEI Corporation: Keracolor S Sanded Grout.
 - e. Parex USA, Inc.: Merkrete DURACOLOR Sanded Grout.
 - f. Approved substitution.
- B. High-Performance Tile Grout: ANSI A118.7.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX FL Rapid Set, Flexible, Sanded Grout.
 - b. Custom Building Products: Polyblend Plus Sanded Grout.
 - c. Laticrete International, Inc.: Permacolor Grout.
 - d. MAPEI Corporation:
 - e. Parex USA, Inc.: Merkrete ProGrout.
 - f. Approved substitution.
 2. Contractor's Option: Contractor may provide either of the following polymer type mortar mixes:
 - a. Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

- b. Acrylic resin or styrene-butadiene-rubber in liquid-latex form for addition to prepackaged dry-grout mix.
 3. Color: As selected by Architect from manufacturer's full color range.
- C. Water-Cleanable Epoxy Grout: ANSI A118.3.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: ARDEX WA High Performance, 100% Solids Epoxy Grout and Adhesive.
 - b. Custom Building Products: EBM-Lite Premium Epoxy Bonding Mortar — 100% Solids.
 - c. Laticrete International, Inc.: Spectralock Pro Premium Grout.
 - d. MAPEI Corporation: Kerapoxy.
 - e. Parex USA, Inc.: Merkrete Pro Epoxy.
 - f. Approved substitution.
 - g.
 - h. Custom Building Products: CEG--Lite 100% Solids Commercial Epoxy Grout.
 - i. Laticrete International, Inc.: Latapoxy 300 Adhesive.
 - j. MAPEI Corporation: Kerapoxy.
 - k. Parex USA, Inc.: Merkrete Pro Epoxy.
 - l.
 - m. Ardex Americas:
 - n. Custom Building Products: CEGLite100% Solids Commercial Epoxy Grout.
 - o. H. B. Fuller Construction Products Inc.; TEC Accu Color EFX Epoxy Morar & Grout TA 440.
 - p. Laticrete International, Inc.: Spectralock Pro Premium Grout.
 - q. MAPEI Corporation: Kerapoxy.
 - r. Parex USA, Inc.: Merkrete Pro Epoxy.
 2. For moisture-sensitive natural stone, cement or agglomerate tile
 3. Verify adhesives have a VOC content of 65 g/L or less.
 4. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F respectively, and certified by manufacturer for intended use.
 5. Color: As selected by Architect from manufacturer's full color range.
- D. Provide other materials, not specifically described but required for a complete and proper installation, subject to approval of Architect.

2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas: Ardex SD-P Rapid.
 - b. Custom Building Products: SpeedSlope Rapid Setting Sloping Mortar.
 - c. Laticrete International, Inc.: L&M Duracrete.
 - d. MAPEI Corporation: Planipatch.
 - e. Parex USA, Inc.: Merkrete Underlay RS
 2. Compressive Strength: ASTM C109; 3,500 psi minimum at 28 days.
 3. Flexural Strength: ASTM C348; 1,000 psi minimum at 28 days.
 4. Set Time: ASTM C191: no more than 1 hour initial.
- B. Metal Transition Strips: Angle or L-shaped transition and edging strips, in height to match adjacent material thicknesses, designed specifically for applications indicated below and on Drawings.
 1. Manufacturers: Subject to compliance with requirements, provide specified products or approved substitutions from one of the following.
 - a. Blanke Corporation.
 - b. Ceramic Tool Company, Inc.
 - c. Emser Tile.

- d. Schluter Systems LP.
- 2. Applications:
 - a. Transition between floor finishes of different heights.
 - b. Expansion and control joints at floors and walls.
 - c. Open edges of floor tile.
 - d. Floor to wall joints.
 - e. Open edges of wall tile.
 - f. Wall corners, outside and inside.
- 3. Lengths: As indicated on Drawings.
- 4. Metal Transition Strip Types: Subject to compliance with requirements, provide the following basis-of-design products by Schluter Systems, LP or approved substitutions.
 - a. MTS-1: Transitions between hard surfaces.
 - 1) Product: SCHIENE Series.
 - 2) Material: Stainless-steel.
 - b. MTS-2: Transitions between carpeting and hard surface.
 - 1) Product: RENO-TK Series.
 - 2) Material: Stainless-steel.
 - c. MTS-3: Edge protection.
 - 1) Product: SCHIENE Series.
 - 2) Material: Solid brass.
 - d. MTS-4: Inside corner for wall-to-wall and wall-to-floor movement transitions.
 - 1) Product: DILEX EKE.
 - 2) Material: 2-piece recycled PVC anchoring legs connected by 5 mm wide replaceable, flexible CPE inserts.
 - e. MTS-5: Movement joint transition exposed to heavy pedestrian and vehicular traffic.
 - 1) Product: DILEX-KS.
 - 2) Material: 2-piece stainless steel [aluminum] anchoring legs connected by 6 mm [11 mm] wide replaceable, flexible, rubber inserts.
 - f. MTS-6: Movement joint transition between tile and fixed building elements.
 - 1) Product: DILEX-BWA.
 - 2) Material: Recycled rigid PVC anchoring leg and dovetail channel connected by 5 mm wide replaceable, flexible CPE inserts.
 - g. MTS-7: Movement joint transition between tile.
 - 1) Product: DILEX-BWS.
 - 2) Material: 2-piece recycled PVC anchoring legs connected by 5 mm wide replaceable, flexible CPE inserts.
 - h. MTS-8: Exposed metal edge.
 - 1) Product: SCHIENE.
 - 2) Material: Brushed stainless steel.
 - i. MTS-9: Outside corner for wall-to-wall transitions.
 - 1) Product: QUADDEC.
 - 2) Material: Brushed stainless steel.
 - j. MTS-10: Vertical outside corner for wall-to-wall transitions.
 - 1) Product: Jolly.
 - 2) Material: Brushed stainless steel.
 - k. MTS-11: Movement cove-shaped joint transition between floor and wall tile.
 - 1) Product: DILEX-AHK.
 - 2) Material and Finish: Brushed chrome anodized aluminum.
- C. Tile Access Panel System: System for creating concealed access panels in tiled walls for electrical and mechanical access. System consists of aluminum brackets with molded casings containing magnets that are clamped to lateral, movable guide shoes, and ferromagnetic metal counter plates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Alpro: ALPRO 2000 Tiled Access Panel.
 - b. Schluter Systems LP: REMA

- c. Tomecanic: Magnetic Tile Access Panel.
 - d. Approved substitution.
- D. Temporary Protective Coating: Product formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
 - 1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- E. Tile Cleaner: 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.
 - 1. Custom Building Products: Aqua Mix Heavy Duty Tile & Grout Cleaner.
- F. Floor Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bonsal American; an Oldcastle company: Grout Sealer.
 - b. Custom Building Products: Aqua Mix Grout Sealer.
 - c. Jamo Inc.: TileLab Grout and Tile Sealer.
 - d. SGM, Inc.: SGM Grout Sealer.
 - e. Summitville Tiles, Inc.: SL-15 Invisible Seal.
 - f. Approved substitution.

2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions. Add materials, water, and additives in accurate proportions.
- B. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 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 thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
 - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of Work, and similar items located in or behind tile has been completed.
 - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations. If not coordinated, adjust joint locations in consultation with Architect.

3.2 PREPARATION

- A. Protect surrounding Work from damage or disfiguration.

- B. Vacuum clean existing surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing surfaces to acceptable flatness tolerances.
- D. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- E. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- F. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- G. 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.
- H. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.
- I. Sound Control Underlayment: Comply with installation requirements in Section 134816 – Manufactured Sound Control Components.

3.3 INSTALLATION OF TILE BACKING PANEL

- A. Install cementitious backer units and treat joints per ANSI A108.11, manufacturer's written instructions, and in compliance with Section 092900.

3.4 INSTALLATION OF WATERPROOFING AND CRACK ISOLATION MEMBRANE

- A. Install waterproofing and crack isolation membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.
- B. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.
- C. Do not install tile or setting materials over membrane until membrane has cured.

3.5 INSTALLATION OF TILE

- A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of 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 ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors composed of tiles 8 by 8 inches or larger.
 - c. Tile floors composed of rib-backed tiles.
- B. Extend tile Work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate Work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. 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 use of pieces that are less than 1/2 of a tile. Provide uniform joint widths unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile: 1/8 inch.
 - 2. Glazed Wall Tile: 1/16 inch.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond 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. Comply with requirements of TCNA, EJ171.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 – Joint Sealers.
- I. Transition Strips: Install at locations indicated, where exposed edge of tile flooring meets carpet or other flooring that finishes flush with top of tile, and where exposed edge of tile flooring meets carpet or other flooring that finishes flush with or below top of tile.

3.6 CLEANING

- A. Cleaning: On completion of placement and grouting, clean ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile per 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. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.7 PROTECTION

- A. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- B. 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.
 - 1. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013

SECTION 095113
ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Acoustical panels and exposed suspension systems for ceilings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate layout and installation of acoustical panels 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.
 2. Suspended Assemblies: Coordinate installation of resilient sound isolation suspension systems with Section 134816 – Manufactured Sound Control Components.
- B. Preinstallation Meeting: Conduct meeting at Project site.
1. Conduct meeting at least 7 days prior to beginning Work of this Section.
 2. Confirm with AHJ if special inspections are required.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
1. Acoustical Panel: 2 sets of 6 inch square Samples of each type, color, pattern, and texture.
 2. Exposed Suspension-System Members, Moldings, and Trim: 2 sets of 6 inch long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by qualified testing agency.
- B. 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 be 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. Acoustical Ceiling Panels: Full-size panels equal to 5 percent of quantity installed.
 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm that specializes in manufacturing of specified acoustical ceiling systems and has been in standard production for a minimum of 3 years.
- B. Installer Qualifications Company specializing in installing specified acoustical ceiling systems with a minimum of 3 years documented experience and authorized and certified by manufacturer to install manufacturer's systems.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store in 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 to reach room temperature and stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet Work in spaces is complete and dry, Work above ceilings is complete, and ambient temperature and humidity conditions are maintained at levels indicated for Project when occupied for its intended use.
 - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.
 - 2. Do not install acoustical ceilings until after carpeting and other interior materials that off-gas have been installed and odors and VOC fumes have dissipated.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of acoustical ceiling system that fail in materials or workmanship within specified warranty period. Warranty is for systems that include both manufacturer's acoustical ceilings and suspension systems.
 - 1. Failures include the following:
 - a. Acoustical Panels: Visible sagging, warping, shrinking, buckling, or delamination.
 - b. Suspension System: Incurring of more than 50 percent red rust as defined by ASTM B117.
 - 2. Warranty Periods:
 - a. Acoustical Panels: 10 years from date of Substantial Completion.
 - b. Suspension System: 10 years from date of Substantial Completion.
 - c. Ceiling System: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension systems, moldings, and accessories from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. Recycled Content: Postconsumer recycled content plus 1/2 of preconsumer recycled content is not less than 50 percent.

- B. Surface-Burning Characteristics: Class A according to ASTM E84; testing by qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.
- C. Seismic Design Criteria:
 - 1. Design lateral bracing to withstand effects of earthquake motions in compliance with requirements of ASCE 7 and local jurisdiction for the following zones and categories:
 - a. Zones: 3 and 4.
 - b. Seismic Categories: D, E, and F.
 - 2. Seismic Separation Joints: Provide seismic separation joints where suspended ceiling areas exceed 2,500 sq. ft. using one of the following methods:
 - a. Seismic Separation Joint Clips: As specified in this Section.
 - b. Walls and Partitions: Extend walls and partitions a minimum of 6 inches above plane of suspension system grid and laterally brace to structure above.
 - c. Soffits: Extend soffits at minimum to align with bottom plane of suspension system grid and laterally brace to structure above.
 - 3. Exemptions:
 - a. Suspended ceiling areas less than or equal to 144 sq. ft. in area and surrounded by walls or partitions connected to structure above are exempt from seismic design requirements.
 - b. Suspended ceiling areas less than 1,000 sq. ft. in area are exempt from lateral force bracing requirements.

2.3 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E795.

2.4 ACOUSTICAL PANELS

- A. Products: See Interior Finish Schedule on Drawings for selected ceiling panel products.

2.5 METAL SUSPENSION SYSTEMS

- A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard, direct-hung, metal suspension systems and accessories according to ASTM C635 and designated by type, structural classification, and finish indicated.
 - 1. Match existing conditions.
- B. Suspended Ceiling Access: As indicated on Drawings, with initial access openings of size indicated on Drawings and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.
 - 1. Initial Access Opening: In each module, 24 by 24 inches or as indicated on Drawings.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System (SUSP-1): Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated or hot-dip galvanized, G30 coating designation; with prefinished 15/16 inchwide metal caps on flanges.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.: Prelude XL 15/16" Exposed Tee.
 - b. CertainTeed Corp.: 15/16" Classic Stab System.
 - c. Rockfon: Chicago Metallic Snap-Grid 200 15/16" Exposed.
 - d. USG Interiors, Inc.: Donn DX Acoustical Suspension System.

2. Structural Classification: Heavy-duty system.
3. End Condition of Cross Runners: Manufacturer's standard end conditions.
4. Face Design: Flat, flush.
5. Cap Material: Cold-rolled steel.
6. Cap Finish: Painted white.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Match existing conditions.

2.7 ACCESSORIES

- A. Attachment Devices: Size for 5 times design load indicated in ASTM C635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A641, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.108 inch diameter wire.
- C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint; size and type to meet application, seismic, and ceiling flatness requirements.
- D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04 inch thick, galvanized-steel sheet complying with ASTM A653, G90 coating designation; with bolted connections and 5/16 inch diameter bolts.
- E. Hold-Down Clips: Manufacturer's standard hold-down.
- F. Seismic End Retaining Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Armstrong World Industries, Inc.: BERC2 Clip.
 - b. CertainTeed Corp.: CTSPC-2.
 - c. Rockfon: Chicago Metallic 1496.00 Seismic Perimeter Clip
 - d. USG Interiors, Inc.: Donn ACM7 Seismic Clip.
 - e. Approved substitution.
- G. Seismic Separation Joint Clips: Manufacturer's standard 2-way separation clips designed to provide axial movement of suspension system during a seismic event.
- a. Seismic Separation Clips:
 - 1) Armstrong World Industries, Inc.: SJMR Series.
 - 2) CertainTeed Corp.:
 - 3) Rockfon: Chicago Metallic 1494.00 Seismic Separation Joint Clip.
 - 4) USG Interiors, Inc.: DH2 2-Way Seismic Expansion Joint Clip.
 - 5) Approved substitution.
 2. Minimum Width: 7/8 inch.
- H. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- I. Seismic Compression Struts: Manufacturer's standard compression struts designed to accommodate seismic forces and for lateral force bracing.
1. Materials: Suspension system manufacturer's proprietary compression strut, metal conduit, or metal studs.
 2. Sizing: Provide compression struts in sizes required by ASCE 7.

2.8 RESILIENT SOUND ISOLATION SYSTEMS

- A. Specified in Section 134816 – Manufactured Sound Control Components, for wire tie ceiling hangers.

2.9 SEALANTS

- A. Acoustical Sealant: Specified in Section 079219 – Acoustical Joint Sealants.
- B. Perimeter Sealant: Silicone-type sealant appropriate for this use. Comply with Section 079200 – Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders. Comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on penetrating items.
- C. Above-Ceiling Observation: Before installing acoustical ceilings, Architect will conduct an above-ceiling observation and report deficiencies in Work observed. Do not proceed with installation of acoustical ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect 7 days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
 - 2. Before notifying Architect, complete the following in areas to receive acoustical ceilings:
 - a. Installation, insulation, and leak and pressure testing of water piping systems.
 - b. Installation of air-duct systems.
 - c. Installation of air devices.
 - d. Installation of mechanical system control-air tubing.

3.3 INSTALLATION

- A. Comply with ASTM C636 and seismic design requirements indicated, according to manufacturer's written instructions, and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-

- system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with minimum of 3 tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches on center along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. 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 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 on center and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. 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 neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. Install panels with pattern running in one direction parallel to axis of space as indicated.
 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. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 5. 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.
 6. Install hold-down impact clips in areas indicated, in areas required by authorities having jurisdiction, and within 20 feet of exterior doors; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
- 3.4 ERECTION TOLERANCES
- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage qualified special inspector to perform the following special inspections:
 - 1. Compliance of seismic design.
- B. Testing Agency: Owner will engage qualified testing agency to perform tests and inspections and prepare test reports.
- C. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for next area until test results for previously completed installations show compliance with requirements.
 - 1. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 pound-force of tension; it will also select 1 of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 pound-force of tension.
 - 2. 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. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust sags or twists that develop in ceiling systems and replace materials which are damaged or faulty.

3.7 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 096513
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Thermoset-rubber base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. 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 6 inches long.
- C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 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. 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.

1.4 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.

1.5 FIELD CONDITIONS

- A. Ambient Conditions:
1. 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 time periods:
 - a. 48 hours before installation.
 - b. During installation.
 - c. 48 hours after installation.
 2. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
 3. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Products shall comply with 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."

2.2 THERMOSET-RUBBER BASE

- A. Products: See Interior Finish Schedule on Drawings for selected resilient base products.
 - 1. Acceptable Manufacturers:
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Johnsonite; A Tarkett Company.
 - e. Roppe Corporation, USA.
 - f. Approved substitution.
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with resilient or other hard surface flooring unless indicated otherwise.
 - 2. Thickness: 0.125 inch minimum.
 - 3. Height: As indicated on Drawings.
 - 4. Lengths: Coils in manufacturer's standard length.
 - 5. Inside and Outside Corners: Job formed.
 - 6. Finish: Satin.
 - 7. Colors and Patterns: As indicated in Interior 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-product manufacturer for resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less and 60 g/L or less for rubber stair treads.
- C. Stair-Tread Nose Filler: 2-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of 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 1,000 sq. ft., and perform no fewer than 3 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/1,000 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 INSTALLATION OF RESILIENT BASE

- 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. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 INSTALLATION OF RESILIENT ACCESSORIES

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING

- 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.

3.6 PROTECTION

- A. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- B. 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 SUMMARY

- A. Section Includes:
1. Resilient sheet floor covering (RF-1)

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
1. Laboratory Test Reports: For floor covering products, indicating compliance with requirements for low-emitting materials.
 2. Product Data: For adhesives, indicating VOC content.
 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 4. Product Data: For chemical-bonding compounds, indicating VOC content.
 5. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
 6. Product Data: For sealants, indicating VOC content.
 7. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
 8. Environmental Product Declaration (EPD): For each product.
 9. Health Product Declaration (HPD): For each product.
 10. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- C. Shop Drawings: For each type of resilient sheet flooring.
1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 2. Show details of special patterns.
- D. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6 by 9 inch sections of each color, texture, and pattern required.
1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- E. Welded Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6 by 9 inch Sample applied to a rigid backing and prepared by Installer for this Project.
- F. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings

1.3 INFORMATIONAL SUBMITTALS.

- A. Qualification Data: For qualified installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for floor coverings.
- C. Moisture and alkali test results.

- D. Slip-Resistance Certification: Manufacturer's certificate indicating that products meet or exceed specified requirements.
- 1.4 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials, from 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 quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet flooring manufacturer for installation techniques required.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Store resilient sheet flooring and installation materials in dry spaces protected from weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.
- 1.8 FIELD CONDITIONS
- A. Ambient Conditions: Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following 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 or more than 95 deg F.
 - C. Close spaces to traffic during and for 48 hours after resilient sheet flooring installation.
 - D. Install resilient sheet flooring after other finishing operations, including painting, have been completed.
- 1.9 WARRANTY
- A. Special Warranty for Resilient Flooring: Manufacturer agrees to repair or replace components of resilient sheet flooring installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of resilient sheet flooring due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Warranty Period: 12 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Verify flooring products comply with requirements of 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. Surface Coefficient of Friction: Provide products that meet the following requirements when tested in accordance with ASTM D2047.
 - 1. Flat Surfaces: 0.6.
 - 2. Inclined Surfaces: 0.8.
 - 3. Wet Surfaces: 0.88
 - 4. Dry Surfaces: 0.92.
- D. Accessibility Requirements: Comply with applicable provisions in U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)" and ICC A117.1.

2.2 SLIP-RESISTANT VINYL SHEET FLOORING WITH BACKING

- A. Slip-resistant sheet flooring material consisting of silicon carbide, aluminum trioxide, and colored quartz aggregate throughout thickness of PVC, complying with the following:
 - 1. Basis-of-Design Product (RF-1): Subject to compliance with requirements, provide the following:
 - a. As indicated on drawings.
 - b. Approved substitution.
 - 2. Performance Criteria:
 - a. Product Standard: ASTM F1303; Type II, Grade 1, Class A, safety flooring.
 - b. Chemical Resistance: Excellent resistance per ASTM F925.
 - c. Mold Resistance: ASTM D3273; shows no signs of mold or mildew.
 - d. Fungi Resistance: ASTM G21; no growth.
 - e. Flexibility: ASTM F137; passes.
 - f. Light Reflectance Value (LRV): 11.
 - 3. Composition:
 - 4. Wear-Layer Thickness: Grade 1, .35 mm.
 - 5. Overall Thickness: 2.5 mm.
 - 6. Interlayer Material: None.
 - 7. Backing Class: Class A (fibrous).
 - 8. Wearing Surface: Textured.
 - 9. Roll Size: 4 x 25 m.
 - 10. Seamless-Installation Method: Heat welded.
 - 11. Backing: foam.
 - 12. Colors and Patterns: As indicated on drawings.
- B. Wearing Surface: Textured
- C. Seamless-Installation Method: Heat welded
- D. Backing: Non-woven polyester/cellulose, glass fiber reinforcement.

2.3 INSTALLATION MATERIALS

1. Basis of Design product is a loose lay installation. See manufacturer guidelines.

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 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 sheet flooring.

3.2 PREPARATION

- A. Prepare substrates per resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring 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 1,000 sq. ft., and perform no fewer than 3 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 per 1,000 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 and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until they are same temperature as space where they are to be installed.
 1. Move resilient sheet flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 INSTALLATION OF RESILIENT SHEET FLOORING

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Unroll resilient sheet flooring and allow them to stabilize before cutting and fitting.
- C. Lay out resilient sheet flooring as follows:
 1. Maintain uniformity of floor covering direction.
 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
 3. Match edges of resilient sheet flooring for color shading at seams.

- 4. Avoid cross seams.
- D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.
- E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of resilient sheet flooring installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.
- H. Comply with manufactures recommended installation. If adhered, adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation: Use one of the following methods unless indicated otherwise.
 - 1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

3.4 CLEANING

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient sheet flooring.
- B. Perform the following operations immediately after completing resilient sheet flooring installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.
 - 1. Apply 2 coats or as many as recommended by flooring manufacturer.

3.5 PROTECTION

- A. Protect resilient sheet flooring products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures until Substantial Completion.
 - 1. Use protection methods recommended in writing by manufacturer.
 - 2. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096516

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Modular carpet tile.
- B. Related Requirements:
 - 1. Section 134816 – Manufactured Sound Control Components, for sound and impact noise control mats.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct meeting at Project site.
 - 1. Review methods and procedures related to carpet tile installation including the following:
 - a. Review delivery, storage, and handling procedures.
 - b. Review ambient conditions and ventilation procedures.
 - c. Review subfloor preparation procedures.

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. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge, Transition, and Other Accessory Stripping: 12 inch long Samples.
- 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 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 2 complete cartons.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer with a minimum of 3 years of experience, who is certified by the International Certified Floorcovering Installers Association at Commercial II certification level.

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 weathertight, wet-Work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during remainder of 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 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 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 from date of Substantial Completion.
 4. Warranty Period: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide specified products from one of the following:
1. Atlas Carpet Mills, Inc.
 2. Bentley Prince Street, Inc.
 3. InterfaceFLOR, LLC.
 4. Mannington Mills, Inc.
 5. Milliken & Company.
 6. Mohawk Group (The); Mohawk Carpet, LLC.
 7. Patcraft; a division of Shaw Industries, Inc.
 8. Shaw Contract Group; a Berkshire Hathaway company.
 9. Tandus Centiva.

2.2 CARPET TILE

- A. Products: See Interior Finish Legend on Drawings for selected carpet tile products.

2.3 SOUND AND IMPACT NOISE CONTROL MATS

- A. Specified in Section 134816 – Manufactured Sound Control Components.

2.4 ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - a. InterfaceFLOR, LLC: Grid-Set Green Glue 2000.
 - b. Approved substitution.
 2. Verify adhesives have a VOC content of 50 g/L or less.
 3. Verify adhesives comply with testing and product requirements of 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. Adhesive Tape: Water-resistant type, compatible with flooring, recommended by manufacturer to suit carpet and substrate conditions indicated, and comply with the following moisture resistant properties:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - a. InterfaceFLOR, LLC: TacTiles GlasBac.
 - b. Shaw Contract Group; a Berkshire Hathaway company: LokDots.
 - c. Approved substitution.
 2. Composition: Compounded acrylic adhesive, applied to PET polyester backing with PET polyester release liner.
 3. Solids: Greater than 99 percent.
 4. Size: 3 inch by 3 inch.
 5. Suitable for use over new concrete substrates with in-situ moisture measurements of up to 80 percent RH as measured by ASTM F2170 or moisture vapor emission rate (MVER) of up to 3 pounds per ASTM F1869, and a pH of 10.

- D. Pressure-Sensitive Adhesive Tabs: Water-resistant, compatible with flooring, recommended by manufacturer to suit carpet and substrate conditions indicated, complying with the following moisture resistant properties:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
 - a. InterfaceFLOR, LLC: TacTiles GlasBac.
 - b. Shaw Contract Group; a Berkshire Hathaway company: LokDots.
 - c. Approved substitution.
 - 2. Composition: Compounded acrylic adhesive applied to PET polyester backing with PET polyester release liner.
 - 3. Composition: Hot-melt adhesive applied to polyester backing with release liner.
 - 4. Solids: Greater than 99 percent.
 - 5. VOC Content: None.
 - 6. Size: 3 inch by 3 inch.
 - 7. Suitable for use over new concrete substrates with in-situ moisture measurements of up to 90 percent RH as measured by ASTM F2170 or moisture vapor emission rate (MVER) of up to 3 pounds per ASTM F1869, and a pH of 10.
- E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.
- F. Resilient Transition Strips: Specified in Section 096513 – Resilient Base and Accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 – Cast-in-Place Concrete and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than 3 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/1,000 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. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and

depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.
- E. Sound Control Underlayment: Comply with installation requirements in Section 134816 – Manufactured Sound Control Components.

3.3 INSTALLATION OF TILE CARPETING

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Manufacturer's recommended Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

3.4 CLEANING

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.

3.5 PROTECTION

- A. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- B. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 098100
ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sound attenuation insulation.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Conduct at Project site.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
1. Product Data: For adhesives, indicating VOC content.
 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 3. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each sound attenuation product type, for tests performed by manufacturer and witnessed by qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
1. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 deg F. or greater than 85 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of sound attenuation insulation from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 5 or less.
 - b. Smoke-Developed Index: 35 or less.

- B. Recycled Content:
 - 1. Postconsumer recycled content plus 1/2 of preconsumer recycled content not less than the following:
 - a. Glass-Fiber Blanket: 50 percent.
 - b. Glass-Fiber Board: 50 percent.
 - c. Bonded Acoustical Pads: 100 percent.

2.3 SOUND ATTENUATION INSULATION

- A. Preformed flexible blanket insulation.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Owens Corning: Pink Next Gen Sound Attenuation Batts
 - b. Acoustical Surfaces, Inc.: UltraTouch Denim Insulation.
 - c. Approved substitution.
 - 2. Thickness: depth of cavity or as indicated on drawings.
 - 3. Color: As selected by Architect from manufacturer's full color range.
 - 4. Mounting Style:
 - a. Provide fasteners: As recommended by manufacturer for complete single source installation.
 - 5. Recycled Content: Postconsumer recycled content not less than 65 percent.
 - 6. Applications:
 - a. Linear ceilings for sound abatement as indicated
 - b. Concealed wall conditions as indicated.

2.4 ACCESSORIES

- A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear wood ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Measure each ceiling area and establish layout of linear wood ceilings to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width or -length panels at borders, and comply with layout shown on Drawings.

3.3 INSTALLATION

- A. Install linear wood ceilings in coordination with suspension system and exposed moldings and trim.
 - 1. Install sound attenuation insulation over wood ceiling at right angle to wood ceiling so insulation does not hang unsupported.
 - 2. Install acoustical insulation above entire linear wood ceiling area.

3.4 ADJUSTING

- A. Adjust sags or twists that develop in ceiling systems and replace materials which are damaged or faulty.

3.5 CLEANING

- A. After Completion of Installation: Clean soiled surfaces.
 - 1. Remove and reinstall improperly installed material.
 - 2. Touch-up moderately damaged wood surfaces with same finish materials as in factory.
 - 3. Remove severely damaged material, discolored material, and moderately damaged material that cannot be properly touch-up finished and replace with new material.

END OF SECTION 098100

SECTION 099000
PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Surface preparation and application of paint and coating systems on interior substrates as specified and indicated on Drawings.
 2. Items indicated in Specifications to be field-painted.

1.2 DEFINITIONS

- A. Paint glosses are defined as sheen ratings of applied paint, according to ASTM D523 and the following MPI values:
1. Gloss Level 1 (Matte or Flat): 0 to 5 units at 60 deg; 10 units maximum at 85 deg.
 2. Gloss Level 2 (Velvet): 0 to 10 units at 60 deg; 10 to 35 units at 85 deg.
 3. Gloss Level 3 (Eggshell): 10 to 25 units at 60 deg; 10 to 35 units at 85 deg.
 4. Gloss Level 4 (Satin): 20 to 35 units at 60 deg, minimum 35 units at 85 deg.
 5. Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 deg.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
1. Include Printout of current "MPI Approved Products List" for each product category specified, with proposed product highlighted.
 2. Indicate VOC content.
- 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. Apply coats on Samples in steps to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.
- 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. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with proposed product highlighted.
 3. Color designations.
 4. VOC content.

1.4 INFORMATIONAL SUBMITTALS

- A. Applicator qualifications.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing type of work of this Section with a minimum of 3 years documented experience.
- B. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Benjamin Moore & Co.
 - 2. Cloverdale Paint Inc.
 - 3. Diamond Vogel Paints.
 - 4. Glidden Professional.
 - 5. Kelly-Moore Paint Company Inc.
 - 6. Miller Paint Company, Inc.
 - 7. PPG Architectural Finishes, Inc.
 - 8. Rodda Paint Co.
 - 9. Rust-Oleum Corporation.
 - 10. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products Lists."
 - 1. If a manufacturer produces more than one product within an MPI category, provide highest quality product within that category.

- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
 - 3. Provide products of same manufacturer for each coat in a coating system.
- C. Material Quality: Material containers not displaying coating manufacturer's product identification will not be accepted.
- D. VOC Content: For field applications that are inside weatherproofing system, verify paints and coatings comply with VOC content limits of authorities having jurisdiction.
- E. Colors: See Finish Legend on Drawings for selected paint and coating colors.

2.3 GALVANIZED METAL CLEANERS/ETCHING

- A. Cleaning, Etching, for Steel, Galvanized Metal: MPI #25.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cloverdale Paint: Cloverdale, ClovaClean, 78100.
 - b. Rust-Oleum: Krud Kutter, Metal Clean and Etch, ME326 or ME014.
 - c. Sherwin-Williams: Great Lakes Laboratories, Clean'n Etch, 899.
 - 2. Field-Applied Etching Cleaner: Use in lieu of SSPC-SP 1 Solvent Cleaning, specified under preparation. Not required for shop primed ferrous metal.

2.4 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Coronado, Super Kote 5000 Latex Primer-Sealer, 40-11.
 - b. Benjamin Moore: Ultra Spec 500, Interior Flat Finish, N534/K534.
 - c. Kelly-Moore: 971 Acryplex, Acryplex Interior PVA Primer Sealer, 971-100.
 - d. Miller Paint: Miller Paint, Premium PVA Primer, 220011.
 - e. PPG Architectural: Glidden Professional (US), PVA Drywall Interior Primer and Sealer, GPD-0000.
 - f. PPG Architectural: PPG Paints, Speedhide Zero Interior Zero VOC Latex Sealer, 6-4900XI.
 - g. Rodda Paint Co.: Master Painter, UL Primer, 503601.
 - h. Sherwin-Williams: ProMar 200 Zero, Interior Latex Primer, B28W02600.
- B. Primer Sealer, Latex, Interior: MPI #61.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Ultra Spec, Latex Vapor Barrier Primer Sealer, 573/K573.
 - b. Cloverdale Paint: Perm Rated Latex Primer Sealer, Vapor Block Perm Rated Latex Primer Sealer, 507901.
 - c. PPG Architectural: PPG Paints, Seal Grip Perm Sealer Vapor Barrier, 17-9801.
 - d. Sherwin-Williams: Moisture Vapor Barrier, Interior Latex Primer/Sealer, B72W00011.
 - 2. Product that provides vapor barrier qualities.
- C. Primer, Alkali Resistant, Water Based: MPI #3.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Ultra Spec, Interior/Exterior Acrylic High-Build Masonry Primer, 609.
 - b. Cloverdale Paint: Prime Solution, Alkali Resistant Primer, 05133.
 - c. Kelly-Moore: 247 AcryShield, AcryShield Acrylic Exterior Masonry Primer, 247-100.
 - d. Miller Paint: Kril, Ext/Int Acrylic Primer/Sealer, 620011.

- e. PPG Architectural: PPG Paints, Perma-Crete Interior/Exterior Alkali Resistant Primer, 4-603XI Series.
- f. Rodda Paint Co.: Prime Solutions, First Coat Universal Bonding Primer, 501601.
- g. Sherwin-Williams: Loxon, Loxon Concrete & Masonry Primer, LX02 Series.

2.5 METAL PRIMERS

- A. Primer, Rust-Inhibitive, Water Based, MPI #107.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Ultra Spec HP, Acrylic Metal Primer, HP04/FP04.
 - b. Cloverdale Paint, Cloverdale Paint, Ecologic Water Borne Shop Primer, 7032 Series.
 - c. Sherwin-Williams: Pro Industrial, Pro-Cryl Universal Primer, B66W1310.
- B. Primer, Alkyd, Anti-Corrosive, for Metal: MPI #79.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AkzoNobel, Devoe High Performance Coatings, Devprime 1409, 1409.
 - b. Benjamin Moore: Corotech, Aliphatic Acrylic Urethane Semi-Gloss, V510.
 - c. Benjamin Moore: Super Spec HP, D.T.M. Alkyd Low Lustre, P23.
 - d. Cloverdale Paint, Cloverdale Paint, Metal Primer Grey, 71307/71309.
 - e. PPG Architectural: Protective and Marine Coatings, Multiprime 4160/Devguard 4160, 4160.
 - f. Rodda Paint Co.: Industrial Primer, Barrier III HS, 708225.
 - g. Sherwin-Williams: Protective & Marine, Kem Kromik Universal Primer, B50WZ Series.
 - 2. Application: Anti-corrosive primer for ferrous metals in industrial or light marine exposures.
- C. Primer, Galvanized, Water Based: MPI #134.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Ultra Spec HP, Acrylic Metal Primer, HP04/FP04.
 - b. Cloverdale Paint, Prime Solutions, Ecologic Waterborne Rustex Primer, 7032 Series.
 - c. Kelly-Moore: 5725 DTM, DTM Acrylic Primer Finish, 5725-100.
 - d. Miller Paint: Acrimetal, Acrimetal DTM Primer/Finish Velvet, 310-2-10.
 - e. Rodda Paint Co.: Prime Solutions, First Coat Bonding Primer, 501601.
 - f. PPG Architectural: High Performance Coatings, Pitt-Tech Plus 4020, 4020 1000.
 - g. Sherwin-Williams: Pro Industrial, Pro-Cryl Universal Primer, B66W1310.
- D. Primer, Vinyl Wash, MPI #80.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sherwin-Williams: Product Finishes, Industrial Wash Primer, P60G2/R7K44.
 - b. Approved substitution.

2.6 WOOD PRIMERS:

- A. Primer, Latex for Exterior Wood: MPI #6.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Insl-X, Prime All Multi-Surface Latex Primer, AP-1000.
 - b. Cloverdale Paint: Prime Solution, Acrylic Latex Stain Blocking Primer, 05130.
 - c. Kelly-Moore: 255 AcryShield, AcryShield 100% Acrylic Exterior Wood Primer, 255-100.
 - d. Miller Paint: Miller-Prime, Int/Ext All Purpose Stain Blocking Primer, 470011.
 - e. PPG Architectural: Glidden Professional (US), Gripper Interior/Exterior Primer and Sealer, GPG-0000.
 - f. PPG Architectural: PPG Paints, Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI.
 - g. Rodda Paint Co.: Prime Solutions, First Coat Universal Bonding Primer, 501601.
 - h. Rust-Oleum: Zinsser, Bulls Eye 123 Plus, 249937.
 - i. Sherwin-Williams: PrepRite ProBlock Primer/Sealer, Interior/Exterior Latex, B51W00620.

- B. Primer, Latex, for Interior Wood, MPI #39.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Insl-X, Prime All Multi-Surface Latex Primer, AP-1000.
 - b. Diamond Vogel: Mill Max, Latex Enamel Undercoat, DU-1508.
 - c. Cloverdale Paint: Prime Solution, Acrylic Latex Stain Blocking Primer, 05130.
 - d. Kelly-Moore: 973 Acryplex, Acryplex Interior Enamel Undercoatd, 973-100.
 - e. PPG Architectural: Glidden Professional (US), Gripper Interior/Exterior Primer and Sealer, GPG-0000.
 - f. PPG Architectural: PPG Paints, Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series.
 - g. Rodda Paint Co.: Unique II, 100% Acrylic Enamel Undercoat, 502001.
 - h. Rust-Oleum: Zinsser, Bulls Eye 123 Plus, 249937.
 - i. Sherwin-Williams: PrepRite ProBlock, Primer Sealer, B51W00620.

2.7 WATER-BASED PAINTS

- A. Latex, Interior, Flat, (MPI Gloss Level 1), MPI #53.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Coronado, Super Kote 5000 Zero VOC Acrylic Latex Flat, 501.
 - b. Benjamin Moore: Ultra Spec 500, Interior Flat Finish, N536.
 - c. Cloverdale Paint: Master Painter, Flat Interior Latex White, 07360.
 - d. Kelly-Moore, 1602 AcryPlex Interior Flat Paint, 1602 AcryPlex Interior Flat Paint, 1602121.
 - e. Miller Paint, Premium, Interior Latex Flat, 120110.
 - f. PPG Architectural: PPG Paints, Speedhide Zero Interior Zero VOC Latex Flat, 6-4110XI.
 - g. Rodda Paint Co.: Rodda Paint, Master Painter Ultra Low VOC Flat, 513601.
 - h. Sherwin-Williams: ProMar 200 Zero VOC, Interior Latex Flat, B30W12651.
- B. Latex, Interior, Semi-Gloss, (MPI Gloss Level 5), MPI #54.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Regal Select, Premium Interior Paint & Primer Semi-Gloss Finish, 551/K551.
 - b. PPG Architectural: PPG Paints, Speedhide Pro-EV Zero Interior Wall & Ceiling Latex Semi-gloss, 12-510XI.
 - c. PPG Architectural: PPG Paints, Speedhide Zero Interior Zero VOC Latex Flat, 6-4510XI.
 - d. Rodda Paint Co.: Rodda Paint Co., Master Painter Ultra Low VOC Semi Gloss Enamel, 543601.
 - e. Sherwin-Williams: ProMar 200 Zero VOC, Interior Latex Gloss, B21W12651.
 - 2. Application: Mildew-resistant coating for use in areas subject to mold and mildew.
- C. Latex, Interior, (MPI Gloss Level 3), MPI #52.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Super Hide, Zero VOC Interior Eggshell, 357/K357.
 - b. Kelly-Moore, 1686 Dura-Poxy, DuraPoxy 100% Eggshell Acrylic Enamel, 1686121.
 - c. Miller Paint, Premium, Interior Satin Wall Finish, 120410.
 - d. PPG Architectural: PPG Paints, Speedhide Zero Interior Zero VOC Latex Satin, 6-4410XI.
 - e. Rodda Paint Co.: Rodda Paint Co., Master Painter UL VOC Eggshell White, 573651.
 - f. Sherwin-Williams: ProMar 200 Zero VOC, Interior Latex Eg-Shel, B20W12651.
- D. Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5), MPI #141.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Benjamin Moore: Ultra Spec 500, Interior Gloss, N540/K540.
 - b. Cloverdale Paint: Performance Plus, High Performance Ultra Low VOC Ecologic Waterborne GL5 Semi-Gloss White, 70623.

- c. Kelly-Moore: 1685 DuraPoxy, DuraPoxy 100% Acrylic Semi-Gloss Enamel, 1685-121.
- d. Miller Paint: Acrinamel, 100% Acrylic Multipurpose Enamel Semi-Gloss, 320510.
- e. PPG Architectural: PPG Paints, Pure Performance Interior Semi-Gloss, 9-510XI Series.
- f. Sherwin-Williams, Pro Industrial, Acrylic Semi-Gloss Coating, B66W00651.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. Interior Steel: SSPC-SP 3.
 - 2. Exterior Steel: SSPC-SP 6 (WAB)/NACE WAB-3.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. 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.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following Work where exposed in equipment rooms:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal and plastic conduit.
 - f. Tanks that do not have factory-applied final finishes.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following Work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal or plastic piping.
 - c. Pipe hangers and supports.
 - d. Metal and plastic conduit.
 - e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

- f. Other items as directed by Architect.
- 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING

- 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.

3.6 PROTECTION

- A. Protect Work of other trades against damage from paint application. Correct damage to Work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 COLOR SCHEDULE

- A. Colors: See Interior Finish Schedule on Drawings for selected painting and coating colors.

3.8 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 - 1. Latex System:
 - a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
 - d. Application:
 - 1) Vertical concrete surfaces not subject to traffic that are not covered in Section 099600.
- B. CMU Substrates:
 - 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
 - d. Application:
 - 1) CMU surfaces schedule for painting that are not covered in Section 099600.
- C. Steel Substrates:
 - 1. High Performance Architectural Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat (PS3): (MPI Gloss Level 5), MPI #141.

- d. Applications:
 - 1) Miscellaneous metals other than hollow metal doors and frames, and pipe and tube railings.
- 2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat (PS13): (MPI Gloss Level 5), MPI #153.
 - d. Applications:
 - 1) Hollow metal doors and frames, and pipe and tube railings that are not covered in Section 099600, and unprimed ferrous metal.
- 3. Water-Based Dry-Fall System:
 - a. Prime Coat: Shop primer specified in Section where substrate is specified.
 - b. Topcoat: Dry fall, latex, flat, MPI #118.
 - c. Applications:
 - 1) Interior, exposed-to-view, overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, and metal fabrications.
- D. Galvanized Metal Substrates:
 - 1. High Performance Architectural Latex System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Interior, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), MPI #141.
 - 1) Applications: Miscellaneous galvanized metals other than hollow metal doors and frames, pipe and tube railings.
 - 2. Water-Based Dry-Fall System:
 - a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.
 - b. Intermediate Coat: Interior, matching topcoat.
 - c. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.
 - d. Applications:
 - 1) Interior, exposed-to-view, overhead-mounted services in utilitarian spaces, including galvanized ducts, galvanized conduit, and galvanized piping
- E. Wood Substrates:
 - 1. Latex over Latex Primer System:
 - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
 - b. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
 - 2. Applications:
 - a. Plywood backing panels, MDF window sills, and wood trim indicated for opaque finish,.
- F. Gypsum Board Substrates:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.
 - d. Topcoat: Latex, interior, eggshell (MPI Gloss Level 3), MPI #52.
 - e. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5), MPI #54.
 - 1) Application: Interior gypsum board not at exterior wall conditions and not scheduled for High Performance Coatings.
 - f. Sheen:
 - 1) Flat: Soffits and ceilings.
 - 2) Eggshell: Walls and other vertical conditions unless indicated otherwise.
 - 3) Semi-Gloss: Janitorial and maintenance rooms, toilet rooms, and other surfaces requiring semi-gloss finish that are not scheduled in Section 099600.
 - g. Note: Ensure surfaces receiving MPI #54 topcoat have a Level 5 drywall finish.
 - 2. Latex over Latex Sealer System Low Permeability:

- a. Prime Coat: Primer sealer, low permeability, latex, interior, MPI #61.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, eggshell (MPI Gloss Level 3), MPI #52.
 - d. Application:
 - 1) Interior gypsum board at exterior wall conditions and interior partitions schedule to receive wall covering.
- G. Cotton or Canvas Insulation-Covering Substrates:
- 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), MPI #53.
 - d. Application:
 - 1) Includes pipe and duct coverings.

END OF SECTION 099000

SECTION 102600
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Corner guards.

1.2 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. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
1. Corner Guards: 12 inches long.
 1. Abuse-Resistant Wall Covering: 6 by 6 inches square.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of handrail.
- B. Material Certificates: For each type of exposed plastic material.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1.5 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.
1. Maintain room temperature within storage area at not less than 70 deg F during period plastic materials are stored.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from same product run, 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 two 48 inch long units.
 2. Mounting and Accessory Components: Amounts proportional to quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
1. Failures include manufacturing defects in metals, metal finishes, and workmanship.

2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition. As selected by Architect.
- B. Surface-Mounted, Metal Corner Guards (: Fabricated as 1-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition. As selected by Architect.

2.3 MATERIALS

- A. Adhesive: As recommended by protection product manufacturer.
 1. Adhesives shall have a VOC content of 70 g/L or less.
 2. Adhesive shall comply with testing and product requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Fasteners: Stainless-steel metal screws compatible with items being fastened. Use security-type fasteners where exposed to view.

2.4 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 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.

2.5 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within 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 Work.
- B. Examine walls to which wall and door protection will be attached for blocking and other solid backing that have been installed in locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 PREPARATION
- A. Complete finishing operations, including painting, before installing wall and door protection.
 - B. Before installation, clean substrate to remove dust, debris, and loose particles.
- 3.3 INSTALLATION
- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in finished Work.
 - B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
 - C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 1. Provide anchoring devices suitable to substrates and locations to withstand imposed loads.
 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
 3. Adjust end and top caps as required to ensure tight seams.
- 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 10 26 41

BALLISTIC-RESISTANT PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Bullet resistant fiberglass panels of the following ballistic rating level:
 - 1. UL 752 Level 3.

1.2 RELATED SECTIONS

- A. Section 09 21 16.33 - Gypsum Board Area Separation Wall Assemblies.

1.3 REFERENCES

- A. International Organization for Standardization (ISO):
 - 1. ISO 9001-2015 - Quality Management System.
- B. National Institute of Justice Ballistic Standards (NIJ):
 - 1. NIJ Standard 0108.01.
- C. Underwriters Laboratories (UL):
 - 1. UL 752 Specifications and Ammunition, 11th addition.
- D. The United States Department of State:
 - 1. The International Traffic in Arms Regulations (ITAR).

1.4 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Details of installation of bullet resistant fiberglass panels.
- C. Certificates: Submit printed data to indicate compliance with the following requirements.
 - 1. UL Listing Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
 - 2. ASTM E 119.
 - 3. ASTM E 1332.
 - 4. Manufacturer's third party certificate of registration with ISO 9001:2008.
 - 5. Manufacturer's U.S. Dept. of State ITAR Statement of Registration.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Sourcing: Panels manufactured in the United States of America with raw materials sourced from the U.S.A. for quality assurance purposes and to comply with any applicable "Buy

American" provisions.

- B. Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.
- C. Installer Qualifications: Minimum 2 year experience installing similar products.
- D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship is approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Deliver materials to project with manufacturer's UL Listed labels intact and legible.
- C. Handle material with care to prevent damage. Store materials inside under cover, stack flat and off the floor.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 WARRANTY

- A. Provide manufacturer's standard limited warranty for materials and workmanship against defects for a period of ten years from the date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ArmorCore: Bullet Resistant Panels
 - 2) Ballistic Board
 - 3) Approved equal.

2.2 BULLET RESISTANT PANELS

- A. General:
 - 1. Bullet Resistant Panels shall be "non-ricochet type" to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

2. Bullet resistance of joints: Equal to that of the panel.
- B. Product: Panels shall be fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets or approved
 - C. Panel Product:
 1. Panel Rating: UL752 Level 3.
 2. Armor Type: NIJ Standard 0108.01 - Type IIIa.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Prior to starting installation, verify work of related trades required in contract documents and architectural drawings is complete to the point where work of this Section may properly commence.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
- B. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4 inches (102 mm), centered on panel joints.
- C. Install panels in accordance with manufacturer's printed recommendations and as required by contract documents.
- D. Secure armor panels using screws, bolts, or an industrial adhesive.
- E. Method of application shall install panels minimizing vulnerabilities by fitting tightly to adjacent surfaces including concrete floor slab, concrete roof slab, bullet resistive door frames, bullet resistive window frames, and other assemblies.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION 102641

SECTION 104416
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.
 - 2. See Section 104413 Fire Protection Cabinets for extinguishers located in cabinets.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.
- B. Preinstallation Meeting: Conduct meeting at Project site.
 - 1. Review methods and procedures related to fire extinguishers including schedules and coordination requirements.

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. Use same designations indicated on Drawings if indicated.

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 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 the following:
 - a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
 - 2. Warranty Period: 6 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- 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.

2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers, General: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Valves: Manufacturer's standard.
 - 2. Handles and Levers: Manufacturer's standard stainless steel.
 - 3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container (Type 1): UL-rated, with monoammonium phosphate-based dry chemical in enameled-steel container.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. JL Industries, Inc.: Model Cosmic 5E.
 - b. Larsen's Manufacturing Company: MP5.
 - c. Potter Roemer LLC. Model Number 3005.
 - d. Approved substitution.
 - 2. Nominal Capacity: 5 lb.
 - 3. UL Rating: 2A:10B:C.
 - 4. Locations: Interior common areas, corridors, other conditioned areas where indicated, and where required by local fire official.
- C. Multipurpose Dry-Chemical Type in Steel Container (Type 2): UL-rated, with monoammonium phosphate-based dry chemical in enameled-steel container.
 - 1. Type 2 Products: Subject to compliance with requirements, provide one of the following:
 - a. JL Industries, Inc.: Model Cosmic 10E.
 - b. Larsen's Manufacturing Company: MP10.
 - c. Potter Roemer LLC. Model Number 3010.
 - d. Approved substitution.
 - 2. Nominal Capacity: 10 lb.
 - 3. UL Rating: 4A-80B:C.
 - 4. Finish Color: Red.
 - 5. Locations: Parking garages, ramps, other unconditioned areas where indicated, and where required by local fire official.

2.4 MOUNTING BRACKETS (TYPE 2 EXTINGUISHER)

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
 - 1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 122413
ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manually operated roller shades with single rollers.

1.2 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 Verification: For each type of roller shade.
 - 1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
 - 2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
 - 3. Installation Accessories: Full-size unit, not less than 10 inches long.
- D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.
 - 1. Recycling Characteristics: Provide documentation that shade cloth is part of a closed loop of perpetual use and not required to be down cycled, incinerated, or otherwise discarded. Scrap material can be sent back to mill for reprocessing and recycling into same quality yarn and woven into new material, without down cycling.
 - a. Certify that this process is currently underway and will be utilized for this Project.
 - 2. Perpetual Use Certification: Certify that at end of useful life of shade cloth, that material can be sent back to manufacturer for recapture as part of a closed loop of perpetual use and that material will be reconstituted into new yarn for weaving into new shade cloth.
- C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than 2 units.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products with minimum of 5 years of experience with specified systems and components.
- 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. Approval of mockups does not constitute approval of deviations from Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 2. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish Work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roller window shades that fail in materials or workmanship within specified warranty period. Chains are not included in warranty.
 - 1. Warranty Periods: From date of Substantial Completion:
 - a. Hardware: 25 years.
 - b. Shade Cloth: 10 years.
 - c. Roller Shade Installation: 1 year, not including scaffolding, lifts, or other means to reach inaccessible areas.

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

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Products: Subject to compliance with requirements, provide the following to match existing blinds that are to remain. Field verify existing conditions:
 - a. Hunter Douglas Duette $\frac{3}{4}$ " pleat.
 - 1) Double Honeycomb Construction with bottom-up Ultra Glide.
 - 2) Semi-opaque except at office areas where they are to be semi-shear (match existing)
 - 3) Color and style to match existing adjacent. Field Verify.

2.3 ROLLERS AND MOUNTING HARDWARE

- A. 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. Match Existing. Field Verify.

B. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

1. Shade Mounting Hardware: Match existing. Field Verify

2.4 INSTALLATION ACCESSORIES

A. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

1. Shape: Match Existing

B. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

1. Height: Match Existing

C. Endcap Covers: To cover exposed endcaps.

D. Installation Accessories Color and Finish: Selected from manufacturer's full range.

2.5 SHADEBANDS

A. Shadeband Material: Light-filtering and light-blocking fabrics to match existing adjacent.

B. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum. Wood hembars are not acceptable.

1. Match existing

2.6 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. Recycled Content of Shadeband Material: Postconsumer recycled content plus 1/2 of preconsumer recycled content not be less than 78 percent.

C. Products: See Interior Finish Schedule on Drawings for selected roller shade fabric products.

2.7 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure

shadeband tracking and alignment through its full range of movement without distortion of the material.

2. Railroaded Materials: Railroad material where material roll width is less than required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, 1 partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ROLLER SHADES

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Roller Shade Locations: Where indicated on Drawings.

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

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

3.5 PROTECTION

- A. 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.
- B. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661.16
SOLID SURFACING COUNTERTOPS

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
- B. Related Requirements:
 - 1. Division 22 Section for Residential Plumbing Fixtures for sinks and plumbing fittings.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals.
 - 1. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Products: See Interior Finish Schedule on Drawings for selected solid surface countertop products.
- B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ISFA 2-01 and NEMA LD 3.
 - 1. Products: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide Signature Series by Cambria as indicated on drawings or approved substitution from one of the following:
 - a. Affinity Surfaces; a brand of Domain Industries, Inc.: Affinity Solid Surface.
 - b. DuPont: Corian.
 - c. Formica Corporation: Formica Solid Surfacing.
 - d. InPro Corporation: Bioprism Solid Surface Counter Tops.
 - e. KRION: Porcelanosa Solid Surface.
 - f. Relang International, LLC: Durasein.
 - g. Transolid, Inc.: Transolid Solid Surface.
 - h. Wilsonart LLC.: Wilsonart Solid Surface.
 - 3. Performance Requirements:
 - a. Fungal Resistance: ASTM G21; no growth.
 - b. Consistency of Color: ISFA SST 2.1-00; Pass.
 - c. Cleanability/Stain Resistance: ISFA SST 3.1-00; less than or equal to 52.
 - d. Visual Defects: ISFA SST 5.1-00; Pass.
 - e. Light Resistance: ISFA SST 7.1-00; no effect.
 - f. Boiling Water Resistance: ISFA SST 8.1-00; no effect.
 - g. High Temperature Resistance: ISFA SST 9.1-00; no effect.
 - h. Radiant Heat Resistance: NEMA LD 3-3.10; 600-plus seconds.
 - i. Flexural Strength: ASTM D790; greater than or equal to 4,000 psi.
 - j. Flexural Modulus: ASTM D790; greater than or equal to 1.00 Mpsi.
 - k. Hardness: ASTM D 2583-13a; Barcol 50 to 70.
 - l. Flatness of Sheets: ISFA SST 4.1-00; less than or equal to 0.063 inch.
 - m. Impact Resistance: ISFA SST 6.1-00; PASS at 60 inches.
 - n. Surface Burning Characteristics: ASTM E84; Class I rated.
 - o. Superficial damage to a depth of 0.010 inch: Repairable by sanding or polishing.
 - 4. Type: Provide Standard type unless Special Purpose type is indicated.
 - 5. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
 - 6. Colors and Patterns: As indicated on drawings.
- C. Composite Wood Products: Verify products are made using ultra-low-emitting formaldehyde resins, as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products," or are made with no added formaldehyde.
- D. Particleboard: ANSI A208.1, Grade M-2.
- E. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to AWS (Architectural Woodwork Standards) or NAAWS (North American Architectural Woodwork Standards).
 - 1. Grade: Premium.
- B. Configuration: As indicated on Drawings.

- C. Countertops: 1/2 inch thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2 inch thick, solid surface material.
- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
 - 2. Install integral sink bowls in countertops in the shop.
- F. Joints: Fabricate countertops without joints when possible.
- G. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
 - 1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - 2. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least 3 splines in each joint.
- H. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
 - 4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Verify adhesives have a VOC content of 70 g/L or less.
 - 2. Verify adhesive complies with testing and product requirements of California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 – Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64 inch difference between planes of adjacent units.

- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints [**where indicated**]. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 – Joint Sealants.

END OF SECTION 123661.16

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sleeves without waterstop.
 2. Sleeves with waterstop.
 3. Sleeve-seal systems.
 4. Grout.
 5. Silicone sealants.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch (0.6-mm) minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.2 SLEEVES WITH WATERSTOP

- A. Description: Manufactured **galvanized steel**, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.

2.3 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.
 - 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel
 - 4. Connecting Bolts and Nuts: Carbon steel, with ASTM B633 coating of length required to secure pressure plates to sealing elements.

2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 3. Using grout seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using **grout** seal the space around outside of sleeves.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.5 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Interior Partitions:
 - a. Sleeves without waterstops.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping and Relocated Existing Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece steel with polished, chrome-plated.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One-piece, floor plate.

2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B16.5 for flanges on steel valves.
- 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 5. ASME B16.18 for cast copper solder-joint connections.
- 6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
- 7. ASME B16.34 for flanged and threaded end connections
- 8. ASME B31.9 for building services piping valves.

- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

- F. Valve Actuator Type:

- 1. Hand Lever: For quarter-turn valves smaller than NPS 4 (DN 100).

- G. Valves in Insulated Piping:

- 1. Provide 2-inch (50-mm) extended neck stems.
- 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
- 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRASS BALL VALVES

- A. Brass Ball Valves, Two Piece with Full Port and Brass Trim, Press Ends:
 - 1. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
 - 2. CWP Rating: Minimum 200 psig (1380 kPa).
 - 3. Body Design: Two piece.
 - 4. Body Material: Forged brass.
 - 5. Ends: Press.
 - 6. Press-End Connections Rating: Minimum 200 psig (1380 kPa).
 - 7. Seats: PTFE or RPTFE.
 - 8. Stem: Brass.
 - 9. Ball: Chrome-plated brass.
 - 10. Port: Full.
 - 11. O-Ring Seal: Buna-N or EPDM.

2.4 BRONZE BALL VALVES

- A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
 - 1. Standard: MSS SP-110; MSS SP-145.
 - 2. CWP Rating: 600 psig (4140 kPa).
 - 3. Body Design: Two piece.
 - 4. Body Material: Bronze.
 - 5. Ends: Threaded or soldered.
 - 6. Seats: PTFE.
 - 7. Stem: Bronze or brass.
 - 8. Ball: Chrome-plated brass.
 - 9. Port: Full.

- B. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Press Ends:
 - 1. Standard: MSS SP-110; MSS SP-145; IAPMO/ANSI Z1157.
 - 2. CWP Rating: Minimum 200 psig (1380 kPa).
 - 3. Body Design: Two piece.
 - 4. Body Material: Bronze.
 - 5. Ends: Press.
 - 6. Press-End Connections Rating: Minimum 200 psig (1380 kPa).
 - 7. Seats: PTFE or RTPFE.
 - 8. Stem: Bronze or brass.
 - 9. Ball: Chrome-plated brass.
 - 10. Port: Full.
 - 11. O-Ring Seal: EPDM or Buna-N.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Brass ball valves, two piece.
 - 2. Bronze ball valves, two piece.

END OF SECTION 220523.12

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze, swing check valves.
 - 2. Bronze, swing check valves, press ends.
 - 3. Iron, swing check valves.
 - 4. Iron, groove-end swing check valves.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, press connections, and weld ends.
 - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
- 2. ASME B16.1 for flanges on iron valves.
- 3. ASME B16.5 for flanges for metric standard piping.
- 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 5. ASME B16.18 for cast-copper solder joint.
- 6. ASME B16.22 for wrought copper solder joint.
- 7. ASME B16.51 for press joint.
- 8. ASME B31.9 for building services piping valves.

- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.

- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- F. Valve Sizes: Same as upstream piping unless otherwise indicated.

- G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE SWING CHECK VALVES

- A. Bronze, Swing Check Valves with Bronze Disc, Class 150:

- 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Design: Horizontal flow.

- d. Body Material: ASTM B62, bronze.
- e. Ends: Threaded or soldered. See valve schedule articles.
- f. Disc: Bronze.

B. Bronze, Swing Check Valves, Press Ends:

- 1. Description:
 - a. Standard: MSS SP-80 and MSS SP-139.
 - b. CWP Rating: Minimum 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B584, bronze.
 - e. Ends: Press.
 - f. Press Ends Connection Rating: Minimum 200 psig (1380 kPa).
 - g. Disc: Brass or bronze.

2.4 IRON, SWING CHECK VALVES

A. Iron, Swing Check Valves with Metal Seats, Class 125:

- 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A126, gray iron with bolted bonnet.
 - e. Ends: Flange or threaded. See valve schedule articles.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

B. Iron, Swing Check Valves with Metal Seats, Class 250:

- 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig (3450 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A126, gray iron with bolted bonnet.
 - e. Ends: Flange or threaded. See valve schedule articles.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.5 IRON, GROOVE-END SWING CHECK VALVES

A. Iron, Groove-End Swing Check Valves, 300 CWP:

- 1. Description:
 - a. CWP Rating: 300 psig (2070 kPa).
 - b. Body Material: ASTM A536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly press.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.
- I. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

- J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze, swing check valves with **bronze** disc.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, soldered, or press-end connections.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flange.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.
 - 6. For Groove-End Copper Tubing and Steel Piping: Groove.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze, swing check valves with **bronze** disc, Class 150, with soldered or threaded end connections.
 - 2. Bronze, swing check valves with press-end connections.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal hanger-shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe-positioning systems.
 - 10. Equipment supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Fiberglass strut systems.
 - 4. Pipe stands.
 - 5. Equipment supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of **stainless steel**.
- C. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL HANGER-SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1.
 - 2. Indoor Applications: Zinc-coated or stainless steel.
 - 3. Outdoor Applications: Stainless steel.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.

3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single-Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two galvanized steel, continuous-thread, 1/2-inch (12-mm) rods.
4. Horizontal Member: Adjustable horizontal, galvanized steel pipe support channels.
5. Pipe Supports: Roller, Strut clamps, Clevis hanger, Swivel hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads.
8. Height: 12 inches (300 mm).

D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.9 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M).
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

- a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal hanger-shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C) pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

- a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners instead of building attachments where required in concrete construction.
- R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Warning tape.
 - 4. Pipe labels.
 - 5. Valve tags.
 - 6. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Letter and Background Color: As indicated for specific application under Part 3.
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

5. Fasteners: Stainless steel rivets or self-tapping screws.
 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch (0.12 mm).
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F (70 deg C).

- F. Minimum Width: 2 inches (50 mm).

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **partially cover** circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.04-inch (1.0-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain, or S-hook.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

- A. Description: Preprinted accident-prevention tags of plasticized card stock.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum
 - 2. Fasteners: Brass grommet and wire

3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 1. White letters on an ANSI Z535.1 safety-green background
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: **Yellow background with black diagonal stripes**
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. (2 m) of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping as per the building's base building standard. Match paint color of existing systems.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. (1 m) of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. (1 m) of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. (8 m) along each run. Reduce intervals to 10 ft. (3 m) in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background
 - 3. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background
 - 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background

3.6 INSTALLATION OF VALVE TAGS

- A. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 - 1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches (38 mm) round.
 - b. Domestic Hot Water: 1-1/2 inches (38 mm) round.
 - c. Domestic Hot-Water Return: 1-1/2 inches (38 mm) round.
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. TAB of domestic water system.
 - 2. TAB of plumbing equipment:
 - a. Domestic hot-water in-line circulation pumps.
 - 3. Pipe-leakage test verification.
 - 4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within **30** days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- D. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.

3. Instrumentation to be used.
 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. hot-water circulating pumps are operational and proper rotation is verified.
 - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - k. Variable-frequency controllers' startup is complete and safeties are verified.
 - l. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Domestic water in-line pumps.
 - 3. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.
 - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

3.7 PROCEDURES FOR MOTORS

- A. Motors: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR WATER HEATERS

- A. Gas- and Oil-Fired Water Heaters:
 1. Measure and record entering- and leaving-water temperatures.
 2. Measure and record water flow.
 3. Measure and record pressure drop.
 4. Measure and Record relief valve(s) pressure setting.
 5. Capacity: Calculate in Btu/h (kW) of heating output.

6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check bearings and other lubricated parts for proper lubrication.
 5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
 1. New filters are installed.
 2. Bearings and other parts are properly lubricated.
 3. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
 2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the system flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

3.10 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
 1. Domestic Water Flow Rate: Plus or minus 10 percent.

3.11 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents, including the following:
 - a. Indicated versus final performance.

- b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
 1. Flow rates.
 2. Pipe and valve sizes and locations.
 3. Balancing stations.
 4. Position of balancing devices.
- E. Gas- and Oil-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Entering-water temperature in deg F (deg C).
 - c. Leaving-water temperature in deg F (deg C).
 - d. Low-fire fuel input in Btu/h (kW).
 - e. High-fire fuel input in Btu/h (kW).
 - f. High-temperature-limit setting in deg F (deg C).
 - g. Operating set point in Btu/h (kW).

- h. Heating value of fuel in Btu/h (kW).
- F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in gpm (L/s).
 - g. Water-pressure differential in feet of head or psig (kPa).
 - h. Required net positive suction head in feet of head or psig (kPa).
 - i. Pump speed.
 - j. Impeller diameter in inches (mm).
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig (kPa).
 - b. Pump shutoff pressure in feet of head or psig (kPa).
 - c. Actual impeller size in inches (mm).
 - d. Full-open flow rate in gpm (L/s).
 - e. Full-open pressure in feet of head or psig (kPa).
 - f. Final discharge pressure in feet of head or psig (kPa).
 - g. Final suction pressure in feet of head or psig (kPa).
 - h. Final total pressure in feet of head or psig (kPa).
 - i. Final water flow rate in gpm (L/s).
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- G. Instrument Calibration Reports:
- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.13 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than **10** percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
1. Domestic cold-water piping.
 2. Domestic hot-water piping.
 3. Domestic recirculating hot-water piping.
 4. Sanitary waste piping exposed to freezing conditions.
 5. Storm-water piping exposed to freezing conditions.
 6. Roof drains and rainwater leaders.
 7. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail attachment and covering of heat tracing inside insulation.
 3. Detail insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.

1.3 QUALITY ASSURANCE

- A. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F (minus 57 deg C) and 220 deg F (104 deg C). Comply with ASTM C534/C534M, Type I for tubular materials.
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F (454 deg C) in accordance with ASTM C411. Comply with ASTM C547.
 - 1. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
 - 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 - 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

- A. compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below 0 deg F (minus 18 deg C).
 - 3. Service Temperature Range: 40 to 200 deg F (4 to plus 93 deg C).
 - 4. Color: Black.
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements

4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
3. Color: White

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm (0.66 metric perms) at manufacturer's recommended dry film thickness.
2. Service Temperature Range: 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
3. Color: White.

2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
2. Service Temperature Range: 0 to plus 180 deg F
3. Color: White.

2.7 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F (Minus 50 to plus 80 deg C)
3. Color: White or gray.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
3. Color: White.

2.8 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White
 3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.
- E. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
 1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
 3. Aluminum Finish: Smooth.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 1. Width: 3 inches (75 mm).
 2. Thickness: 11.5 mils (0.29 mm).
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Width: 2 inches (50 mm).
2. Thickness: 6 mils (0.15 mm).
3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.11 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
2. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range of between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 1. Install pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
 2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) o.c. and at end joints.

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 (DN 25) Smaller: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.
 - 2. NPS 1-1/4 (DN 32) and Larger: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/4 (DN 32) and Smaller: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation is one of the following:
 - a. Flexible Elastomeric: 1.5 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1.5 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1.5 inch thick.

C. Stormwater and Overflow:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

D. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

F. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

G. Hot Service Vents:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch (25 mm) thick.

3.13 IN UNCONDITIONED ATTIC, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Water Piping:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 2 inches (50 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation is one of the following:
 - a. Flexible Elastomeric: 2 inches (50 mm) thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. PVC: 20 mils (0.5 mm) thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. PVC: 20 mils thick.

3.16 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning plumbing systems, subsystems and equipment.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 22.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are noted below:

- 1. Domestic Hot Water Systems including Hot Water Heater and Recirc Pump

1.3 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 22 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements of Division 22, is required in cooperation with the Owner and the Commissioning Agent.

1.4 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Contractor will submit a list of submittals. The Commissioning Agent will review the list and identify submittals that require review. Contractor will deliver submittals identified by Commissioning Agent.
- B. The commissioning process requires Submittal review simultaneously with engineering review.

1.5 RELATED WORK

- A. Section 230800 – Commissioning of Mechanical Systems
- B. Section 260800 – Commissioning of Electrical Systems

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Manufacturer shall include required proprietary test equipment. Manufacturer shall furnish the test equipment, demonstrate its use, and assist the Commissioning Team in the commissioning process.

PART 3 - EXECUTION

3.1 SITE OBSERVATIONS

- A. Commissioning of the Building Plumbing Systems will require inspection of individual elements of the Plumbing construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Functional Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists through online Commissioning tool. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information submitted in the checklist is not accurate, the Commissioning Agent will mark the checklist "In Progress" and the Contractor will make the corrections and resubmit. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be marked "In Progress" and the Contractor will make the corrections and resubmit.

3.3 CONTRACTOR'S TESTS

- A. Contractor tests, as required by other sections of Division 22, shall be scheduled and documented and submitted for review. All testing shall be incorporated into the project schedule. Contractor shall allow no less than 7 days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Functional Testing.

3.4 FUNCTIONAL TESTING

- A. The Commissioning Process includes Functional Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Functional Test procedures. The Contractor shall review and comment on the tests prior to approval. The Contractor shall include the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing.

3.5 TRAINING

ELMORE COUNTY
ADMINISTRATION REMODEL
MOUNTAIN HOME, ID

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner and Commissioning Agent. Include competent, factory authorized personnel to deliver instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas. The instruction shall be scheduled in coordination with the Owner after submission and approval of formal training plans. Refer to Division 22 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Copper tube and fittings.
 2. Ductile-iron pipe and fittings.
 3. Piping joining materials.
 4. Encasement for piping.
 5. Transition fittings.
 6. Dielectric fittings.

1.2 ACTION SUBMITTALS

- A. Product Data:
1. Pipe and tube.
 2. Fittings.
 3. Joining materials.
 4. Transition fittings.

- B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper (hard) Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) ASTM B88, Type L (ASTM B88M, Type B and ASTM B88, Type M (ASTM B88M, Type C).
- B. Annealed-Temper (soft) Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) ASTM B88, Type L (ASTM B88M, Type B) and ASTM B88, Type M (ASTM B88M, Type C).
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.
 - 1. Description: Tee formed in copper tube in accordance with ASTM F2014.
- H. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
 - 1. Grooved-End, Copper Fittings: ASTM B75 (ASTM B75M) copper tube or ASTM B584 bronze castings.
 - 2. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F (80 deg C) for use with ferrous housing and steel bolts and nuts; 300 psig (2060 kPa) minimum CWP pressure rating.
- I. Copper Tube, Pressure-Seal-Joint Fittings:
 - 1. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.
 - 2. Minimum 200-psig (1379-kPa) working-pressure rating at 250 deg F (121 deg C).
- J. Copper-Tube, Push-on-Joint Fittings:
 - 1. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
 - 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 - 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.

G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.

- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: **Sheet or tube.**
- C. Color: Black or natural.

2.6 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C)
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Standard: ASSE 1079.
 - 2. Factory-fabricated, bolted, companion-flange assembly.
 - 3. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
 - 4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
 - 1. Nonconducting materials for field assembly of companion flanges.
 - 2. Pressure Rating: 150 psig (1035 kPa)
 - 3. Gasket: Neoprene or phenolic.
 - 4. Bolt Sleeves: Phenolic or polyethylene.
 - 5. Washers: Phenolic with steel backing washers.

- E. Dielectric Nipples:
 - 1. Standard: IAPMO PS 66.
 - 2. Electroplated steel nipple complying with ASTM F1545.
 - 3. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - 4. End Connections: Male threaded or grooved.
 - 5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) cast or wrought, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) copper push-on-joint fittings; and push-on joints.
- D. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) cast or wrought, solder-joint fittings; and soldered joints.
 - 2. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Drawn-temper copper tube, ASTM B88, Type L (ASTM B88M, Type B) grooved-joint, copper-tube appurtenances; and grooved joints.

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- C. Install valves according to the following:
 - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - 2. Section 220523.14 "Check Valves for Plumbing Piping."

- D. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."
- O. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- P. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.

2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
3. PVC Piping: Join according to ASTM D2855.

N. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF TRANSITION FITTINGS

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.5 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) Use dielectric flanges.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for piping with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches (300 mm) of each fitting.

D. Support vertical runs of piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Balancing valves.
3. Temperature-actuated, water mixing valves.
4. Strainers for domestic water piping.
5. Outlet boxes.
6. Drain valves.
7. Water-hammer arresters.
8. Trap-seal primer device.
9. Trap-seal primer systems.
10. Flexible connectors.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers
 1. Standard: ASSE 1001.
 2. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
 3. Body: Bronze.
 4. Inlet and Outlet Connections: Threaded.
 5. Finish: Rough bronze.

2.4 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves
 1. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 2. Body: Brass or Bronze
 3. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
 4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Memory-Stop Balancing Valves
 1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
 3. Size: NPS 2 (DN 50) or smaller.
 4. Body: Copper alloy.
 5. Port: Standard or full port.
 6. Ball: Chrome-plated brass or stainless steel.
 7. Seats and Seals: Replaceable.
 8. End Connections: Solder joint or threaded.

9. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices

1. Standard: ASSE 1070.
2. Pressure Rating: 125 psig (860 kPa).
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 105°F
8. Tempered-Water Design Flow Rate: See Plans
9. Valve Finish: **Rough bronze**.

B. Primary, Thermostatic, Water Mixing Valves

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded[union] inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 120°F.
8. Tempered-Water Design Flow Rate: See plans
9. Selected Valve Flow Rate at 45-psig (310-kPa) Pressure Drop: See Plans.
10. Pressure Drop at Design Flow Rate: 10 PSIG
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.

C. Individual-Fixture, Water Tempering Valves

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
3. Material: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Connections: Threaded inlets and outlet.
6. Finish: Chrome plated.
7. Tempered-Water Setting: 105°F

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves >:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal Bellows or Piston
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.9 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.10 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa)
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
 - 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- B. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.
- C. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- D. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Y-Pattern Strainers: For water, install on supply side of pump.
- F. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- G. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- H. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- I. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum breakers.
 - 2. Balancing valves.
 - 3. Temperature-actuated, water mixing valves.
 - 4. Trap-seal primer device.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each device in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections

1. Test each device according to authorities having jurisdiction and the device's reference standard.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Hubless, cast-iron soil pipe and fittings.
 2. Galvanized-steel pipe and fittings.
 3. Stainless steel drainage pipe and fittings.
 4. Ductile-iron pipe and fittings.
 5. Copper tube and fittings.
 6. ABS pipe and fittings.
 7. PVC pipe and fittings.
 8. Specialty pipe fittings.
 9. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10 ft. head of water (30 kPa head of water)

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 1. Marked with CISPI collective trademark.
 2. ASTM A888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
 1. Standards: ASTM C1277 and CISPI 310.
 2. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
 1. Standards: ASTM C1277 and ASTM C1540.
 2. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.4 GALVANIZED-STEEL PIPE AND FITTINGS

- A. Galvanized-Steel Pipe: ASTM A53/A53M, Type E, standard-weight cast iron. Include square-cut-grooved or threaded ends matching joining method.
- B. Cast-Iron Drainage Fittings: ASME B16.12, threaded.
- C. Steel Pipe Pressure Fittings:
 1. Galvanized-steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless steel pipe. Include ends matching joining method.
 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
 3. Galvanized-Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- D. Cast-Iron Flanges: ASME B16.1, Class 125.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.5 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, drawn temper.
- D. Soft Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, annealed temper.
- E. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.6 PVC PIPE AND FITTINGS

- A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F891, Schedule 40.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
- F. Solvent Cement: ASTM D2564.

2.7 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
 4. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 5. Pressure Transition Couplings:
 - a. Standard: AWWA C219.
 - b. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: Manufacturer's standard.
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig (1035 kPa).
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig (1035 kPa).

- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric Nipples:

a. Description:

- 1) Standard: IAPMO PS 66.
- 2) Electroplated steel nipple.
- 3) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C)
- 4) End Connections: Male threaded or grooved.
- 5) Lining: Inert and noncorrosive, propylene.

2.8 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or Tube.
- D. Color: Black or Natural.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.

- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 - 3. Vent Piping: Onepercent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- N. Install steel piping in accordance with applicable plumbing code.
- O. Install stainless-steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
- P. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- Q. Install aboveground ABS piping in accordance with ASTM D2661.
- R. Install aboveground PVC piping in accordance with ASTM D2665.

- S. Install underground **PVC** piping in accordance with ASTM D2321.
 - 1.
 - T. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - U. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - V. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - W. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - X. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.2 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
 - C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets in accordance with ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- J. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches (125 mm) and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches (100 mm) and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches (125 mm) and larger, upstream and downstream of all changes in direction and branch openings.

3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100) Use dielectric flanges
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52 spring hangers.

B. Install hangers for **cast-iron** soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- D. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, and coupling.
- E. Support vertical runs of Cast-Iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor
 - 6. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water (30 kPa head of water).
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg (250 Pa).
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be any of the following:
 - 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings CIPSI hubless-piping couplings; and coupled joints.
 - 3. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be any of the following:
 - 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 (DN 100) and smaller is to be any of the following:
 - 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 3. Solid-wallPVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 (DN 125) and larger is to be any of the following:
 - 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.

4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be any of the following:
1. Extra Heavy or Service class cast-iron soil piping; gaskets; and gasketed joints.
 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be any of the following:
1. Extra Heavy or Service class cast-iron soil piping; gaskets; and gasketed joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Air-admittance valves.
 - 4. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show fabrication and installation details for frost-resistant vent terminals.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves
 1. Standard: ASME A112.14.1.
 2. Size: Same as connected piping.
 3. Body: Cast iron.
 4. Cover: Cast iron with bolted or threaded access check valve.
 5. End Connections: Hub and spigot or hubless
 6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition
 7. Extension: ASTM A74, Service Class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves
 1. Size: Same as floor drain outlet.
 2. Body: Cast iron or bronze; made for vertical installation in bottom outlet of floor drain.
 3. Check Valve: Removable ball float.
 4. Inlet: Threaded.
 5. Outlet: Threaded or spigot.

2.3 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts
 1. Standard: ASME A112.36.2M.
 2. Size: Same as connected drainage piping
 3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure: Countersunk plug.
 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Cast-Iron Wall Cleanouts
 1. Standard: ASME A112.36.2M. Include wall access.
 2. Size: Same as connected drainage piping.
 3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 4. Closure Plug:
 - a. Brass
 - b. Countersunk head.

- c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.
 6. Wall Access, Frame and Cover: Round nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains

1. Description: Shop or field fabricate from ASTM A74, Service Class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping **with increaser fitting of size indicated.**

B. Deep-Seal Traps

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

D. Floor-Drain, Inline Trap Seal

1. Description: Inline floor drain trap seal, forming a physical barrier to slow trap evaporation while not impeding flow from drain.
2. Material: Polymer.
3. Standard: Tested and certified in accordance with ASSE 1072.
4. Listing: IAPMO listed.
5. Size: Same as floor drain outlet or strainer throat.

E. Air-Gap Fittings

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

F. Vent Caps

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Frost-Resistant Vent Terminals

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

H. Expansion Joints

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor.

F. Install deep-seal traps on floor drains and other waste outlets, if indicated.

- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- M. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- N. Install wood-blocking reinforcement for wall-mounting-type specialties.
- O. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene.
- D. PE: Polyethylene.
- E. PP: Polypropylene.
- F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains: Refer to Plumbing Schedule for Specifications:

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
1. Set grates of drains flush with finished surface, unless otherwise indicated.
- C. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
1. Install on support devices, so that top will be flush with adjacent surface.
- D. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.
- E. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.
- D. Install piping adjacent to equipment to allow service and maintenance.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Product Certificates: For each domestic-water heater.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Gas-Fired, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Two year(s).
 - 3) Burner: Five Years
 - b. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
 - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Refer to plumbing schedules for additional specifications and capacity requirements.
2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: ANSI Z21.10.3/CSA 4.3.
4. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
5. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
 - 1) NPS 2 (DN 50) and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) NPS 2-1/2 (DN 65) and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges and in accordance with ASME B16.24 for copper and copper-alloy flanges.
6. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
 - c. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - d. Insulation: Comply with ASHRAE/IES 90.1. Surround entire storage tank except connections and controls.
 - e. Jacket: Steel with enameled finish.
 - f. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and **natural-gas** fuel.
 - g. Temperature Control: Adjustable thermostat.
 - h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
2. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
3. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
4. Capacity and Characteristics:
- a. Working-Pressure Rating: 100 psig (690 kPa).
 - b. Capacity Acceptable: 7 gal. (26.5 L) minimum.
 - c. Air Precharge Pressure: 50 psig.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 (DN 20) with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Comply with requirements for ball- shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping,"
1. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1, manually operated. Furnish for installation in piping.
- G. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 2-psig (13.8-kPa) pressure rating as required to match gas supply.
- H. Automatic Gas Valves: ANSI Z21.21/CSA 6.5, appliance, electrically operated, on-off automatic valve.
- I. Pressure Relief Valves: Include pressure setting less than working-pressure rating of domestic-water heater.
1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4.
 2. Oil-Fired, Domestic-Water Heaters: ASME rated and stamped.
- J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Provide dimension that will support bottom of domestic-water heater minimum of 18 inches (457 mm) above the floor.
- K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 8. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
 - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.

2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
 3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.
 4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 231123 "Facility Natural-Gas Piping."
- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.
- J. Fill domestic-water heaters with water.
- K. Charge domestic-water expansion tanks with air to required system pressure.
- L. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.
- 3.2 PIPING CONNECTIONS
- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."

- B. Comply with requirements for gas piping specified in Section 231123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections
- E. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Domestic-water heaters will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 223400

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor-mounted, bottom-outlet water closets.
- B. Related Requirements:

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. (6 L) per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. (4.8 L) or less per flush.
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include diagrams for power and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Flushometer-Valve Repair Kits: six of each type.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
5. Comply with ASME A112.6.1M for water-closet supports.
6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

- #### A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud: Refer to Plumbing Fixture Schedule for specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- #### B. Examine walls and floors for suitable conditions where water closets will be installed.
- #### C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.
5. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Vitreous-china, undercounter-mounted lavatories.
 2. Manually operated lavatory faucets.
 3. Automatically operated lavatory faucets.
 4. Supply fittings.
 5. Waste fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

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. Faucet Washers and O-Rings: Equal to 4 of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 4 of each type and size installed.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory - Rectangular, Vitreous China, Undercounter Mounted. Refer to Plumbing Schedules for Specifications.
- B. Lavatory - Oval Vitreous China, Undercounter Mounted. Refer to Plumbing Schedules for Specifications.

2.2 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets – Refer to Plumbing Schedules for Specifications.

2.3 AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Lavatory Faucets - Automatic Type: **Battery Powered**. Refer to Plumbing Schedules for Specifications.

2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle

F. Risers:

1. NPS 1/2 (DN 15).
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces riser.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32)
2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall and chrome-plated, brass or steel wall flange.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate to be laminated acrylic or melamine plastic signs.
 - 2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.

- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Service sinks.
 - 2. Kitchen/utility sinks.
 - 3. Handwash sinks.
 - 4. Sacristy sinks.
 - 5. Shampoo bowls.
 - 6. Manually operated sink faucets.
 - 7. Automatically operated sink faucets.
 - 8. Supply fittings.
 - 9. Waste fittings.
 - 10. Sink supports.
 - 11. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments for automatic faucets.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 KITCHEN/UTILITY SINKS

- A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: Refer to Plumbing Schedules for Specifications.
 1. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Wheel handle.
 - 2) Risers: NPS 1/2 (DN 15), chrome-plated, rigid-copper pipe
 2. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 2 (DN 50).
 - 2) Material:
 - a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall and chrome-plated brass or steel wall flange.
 3. Mounting: On counter with sealant.

2.2 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Single-control mixing. Refer to Plumbing Schedules for Specifications.
 - 1. Source Limitations: Obtain sink faucets from single source from single manufacturer.
 - 2. Standard: ASME A112.18.1/CSA B125.1.
 - 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 - 4. Vacuum Breaker: **Required** for hose outlet.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle
- F. Risers:
 - 1. NPS 1/2 (DN 15).
 - 2. Chrome-plated, rigid-copper pipe.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 (DN 40) offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2 (DN 40).
 - 2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

2.5 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks.

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least **1/2 inch (13 mm)** high.

3.5 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224713 - DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Drinking fountains.
 - 2. Bottle filling stations.
 - 3. Supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For **drinking fountains and bottle filling stations** 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. Filter Cartridges: Equal to 4 of each.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Drinking fountains and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
2. Comply with ASME A112.19.3/CSA B45.4 for stainless steel drinking fountains and bottle filling stations.
3. Comply with NSF 42 and NSF 53 for water filters for drinking fountains and bottle filling stations.
4. Comply with ICC A117.1 for accessible drinking fountains and bottle filling stations.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains - Surface Wall-Mounted, Stainless Steel: Refer to plumbing schedules for additional specifications. Provide with compatible bottle filling kit.

1. Electrical Characteristics:
 - a. Volts: 120 V ac.
 - b. Phase: Single.
 - c. Hertz: 60 Hz.
2. Support: Provide manufacturer's mounting plate **and drinking fountain carrier**.
3. Drinking Fountain Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping".
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Install valve upstream from filter for drinking fountain. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplates to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.6 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 226313 – FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. General: Provide gas systems in accordance with the Contract Documents.

1.2 Reference Standards:

- A. Comply with applicable provisions and recommendations of the following Codes:
 - 1. Local Code and Amendments
 - 2. 2018 Uniform Plumbing Code
 - 3. International Fuel Gas Code (IFGC) 2018 Edition
 - 4. Refer to Contract Documents for additional reference standards.
- B. Provide gas systems in accordance with the intent of the Contract Documents. Install all gas services meter rigs, regulators, etc., in accordance with the provisions of gas serving company and obtain all necessary approvals.
- C. Make arrangements to hook up new gas utilities to the existing gas service within the building.
- D. Gas service contract limit line as indicated on the Drawings.

1.3 SUBMITTALS

- A. Manufacturer's product data, including equipment capacity and pressure ratings, for the following:
 - 1. Pipe and fittings
 - 2. Gas service and transition risers
 - 3. Valves
 - 4. Regulators

- B. Submit proof of certification for personnel responsible for making heat fusion bonded joints in plastic piping.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data for the following:
 - 1. Valves
 - 2. Regulators

PART 2 - PRODUCTS

2.1 BELOW GRADE PIPING AND FITTINGS

- A. Piping: Polyethylene piping yellow in colour, with heat fusion weld joints, Type II, ASTM D2513, ASTM 2683, ASTM D 3261, PE 2406, where approved by local gas company standards.
 - 1. 1-inch NTS SDR 12.5
 - 2. 1¼-inch NTS SDR 13.9
 - 3. 1¼-inch IPS SDR 10
 - 4. 2 inches IPS SDR 11
 - 5. 3 inches IPS SDR 11.5
 - 6. 4 inches IPS SDR 11.5
 - 7. 6 inches IPS SDR 11.5
 - 8. 8 inches IPS SDR 11.5
 - 9. 10 inches IPS SDR 11.0

- B. Transition Fittings: Steel to polyethylene pipe transition couplings and risers shall conform to ASTM D2513 & D2683 & ANSI B31.8 & DOT 192.121, ANSI B1.20, where applicable and meet design, material and construction standards of gas service company. Provide all accessories and fittings required for complete installation at building gas riser location.

- C. Tracer Wire: Single conductor with green coating and minimum size No. 12 AWG stranded copper.
 - D. Buried Pipe Tape: 2 inches wide, safety yellow color code, heavy gauge .035-inch, detectable aluminum film including following text: “CAUTION Gas line buried below”.
 - 1. Acceptable manufacturers/products include:
 - a. Seton Name Plate Company
 - b. EMED Co., Inc., Buffalo, New York
 - c. Enterprises, Inc., Waterloo, Michigan
 - d. “Magnetec” by Thor Enterprises, Inc., Waterloo, Michigan
 - E. Underground at Service Entrance: Same as Above-ground covered with a flexible polymer film with coal tar and synthetic elastomeric coating of 36-mil thickness or extruded high-density polyethylene factory applied coating of 30 mil. thickness. Wrap fittings with 10-mil polyethylene tape, ANSI A21.5, double layer, half-lapped. Minimum dielectric strength exceeding 12kV. Use compatible primer below polymer film or polyethylene tape.
- 2.2 ABOVE GRADE PIPING AND FITTING MATERIALS WHERE SUBJECT TO IMPACT DAMAGE – CARBON STEEL PIPE AND FITTINGS
- A. General Characteristics for Threaded Pipe and Fittings:
 - 1. Field Pipe Threading: Comply with National Fuel Gas Code “Table I Specifications for Threading Metallic Pipe” for length of threaded portion of pipe and number of threads to be cut.
 - 2. Metallic Pipe and Fittings Threads: Taper pipe threads complying with Standard for Pipe Threads, General Purpose, [ANSI/ASME B1.20.1](#).
 - 3. Thread Compounds: Resistant to action of chemical constituents of gases to be conducted through piping systems and labeled by manufacturer accordingly.
 - B. Above Grade Interior Piping: Piping: ASTM A106 Gr B, or A-53 B seamless, Schedule 40, carbon steel pipe.
 - C. Above Grade Exterior Piping: Piping: ASTM A106 Gr B, or A-53 B seamless, Schedule 40, carbon steel pipe, prime coated and 2 coats of exterior grade paint after installation and testing. Paint color: yellow.

D. Fittings:

1. Pipe sizes 2½ inches and smaller:
 - a. Interior 150# black malleable iron screwed fittings.
 - b. Exterior 150# black malleable iron screwed fittings, primed coated and 2 coats of exterior grade paint. Paint color: yellow.
2. Joints: Red or white lead and oil or approved pipe compound.

2.3 ABOVE GRADE PIPING AND FITTING MATERIALS CONCEALED AND PROTECTED PIPING – CORROUGATED STAINLESS STEEL

A. Corrugated, Stainless-Steel Tubing Complying with ANSI/IAS LC 1//CSA 6.26, and Protective Jacket System Complying with ICC-ES PMG LC 1027.

1. Basis-of-Design Product: Subject to compliance with requirements, provide FlashShield Products; Gastite, a division of Titeflex Corp.; FlashShield System Corrugated Stainless Steel Tubing (CSST), or a comparable product by the following:
2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
3. Coating: Multilayer consisting of a metal shield between two semi-conductive polymer layers as well as being UV-resistant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with FlashShield tubing and capable of a metal-to-metal seal without gaskets. The fitting also includes a metal locking feature for enhanced electrical continuity and jacket-lock which eliminates exposed steel beyond the nut. Include brazing socket or threaded ends complying with ASME B1.20.1.
5. Striker Plates: Steel, designed to protect tubing from penetrations.
6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
7. Operating-Pressure Rating: 25 psig (172.4 kPa).

2.4 VALVES

- A. Lubricated Plug Valves: U.L. Listed, valves, ASTM-A-126 Grade B steel body and plug material, suitable for natural gas service and pressures up to 200 psi, with close tolerance between the plug and body sealing surfaces, reinforced Teflon stem seal, leak-proof spring loaded ball and lubricant sealed check valve; and combination lubricant screw and button head fitting to prevent foreign matter from being forced into lubricant system. Valve plugs are to be floated on low-friction Teflon surfaces for extra ease of turning - the lower surface to also act as a means of minimizing torsional stress in the spring - and are to have port area equal to 100 percent of the area of standard pipe. Valves are to be so constructed that lubricant system has sufficient pressure to force lubricant over all seating surfaces. Extruded Lubricant around stem is to be positive indication that lubricant system is full, and that there had been a minimum contamination of line fluids. Lubricant shall be suitable for hydrocarbons, L.P.G. and natural gas. Similar to the following:
1. Interior manual gas valves (½-inch to 2½-inch size): Screwed ends, lever actuation, and lever handle; “Series 601” by [Homestead® Valve Division of Olson Technologies](#).
 2. Interior manual gas valves (3-inch to 6-inch size): Flanged ends, lever actuation, and lever handle, “Series 602 and 622” by [Homestead® Valve Division of Olson Technologies](#).
 3. Exterior manual gas valves (3-inch to 6-inch size): Permanently lubricated plug valve, lever actuation, and lever handle, “Roots Style 350” by DMD/Dresser.
- B. Ball Valves (½-inch - 2-inch size): Bronze ball valve with B16 chrome plated brass ball and threaded ends; vinyl-coated steel handle; factory-tested under water with air pressure in open and closed positions. Listed by Underwriters Laboratories as natural gas shut-off valve and labeled accordingly; “Series 80-100” by [Apollo](#).
- C. Check Valves: Bronze swing check valve with soft resilient disc, suitable for natural gas service. “B-320BC, Class 125, threaded ends, with BUNA-N Disc” by [Stockham](#).
- D. Earthquake Valve: Earthquake ball type actuated automatic gas shut off valve, listed by UL & Certified by California State Architect in accordance with ASCE 25-97, sized for minimum pressure drop of 0.1-inch water column at total connected gas load, “Koso/California Series 300” by Pacific Seismic Products.

2.5 Pressure Regulating Valves

- A. ¾-Inch Pipe Size:

1. Lower Diaphragm Case: Die cast aluminum with a exclusive 7-step advance conversion coating, single coat polyester and High Polyurethane Top Coat
 2. Top Assembly: Die cast aluminum with a exclusive 7-step advanced conversion coating, single coat polyester primer and High Solid Polyurethane Top Coat
 3. Pressure Spring: Steel, zinc plated and yellow chromate treated. Color coded for identification
 4. Diaphragm Plate: Steel, plated
 5. Seat Disc: Buna-N
 6. Orifice: High strength, corrosion resistance, aluminum
 7. Lever: Stamped aluminum
 8. Seal Plug: Ultraviolet stabilized, mineral filled nylon
 9. ¾-inch pipe size
 10. 5-inch w.c to 7½-inch w.c. outlet pressure regulation
 11. Removable weather and bug-proof stainless steel screened ¾-inch NPT vent to resist freeze-ups and to exclude foreign matter
 12. Design Conditions: Inlet pressure 5 psi outlet pressure 7-inch w.c. with minimum capacity: 32 scfh
 13. "S-253" by Fisher or: "CR-4000-180" by American Meter
- B. 2-inch pipe size, flanged connections, spring color Green for 6-inch w.c to 14-inch w.c. outlet pressure regulation, die cast aluminum alloy diaphragm case and cast iron body, diaphragm type regulator valve, internal control tube for pressure control, straight body with flow horizontal and vent outlet pointing downward. Provide regulator meeting following design conditions: Inlet pressure 5 psi, outlet pressure 8-inch w.c. Capacity: 4241 scfh, "Model 122-12" by [Equimeter](#).
- C. 2-inch pipe size, flanged connections, spring color Green for 6-inch w.c to 14-inch w.c. outlet pressure regulation, die cast aluminum alloy diaphragm case and cast iron body, diaphragm type regulator valve, internal control tube for pressure control, straight body with flow horizontal and vent outlet pointing downward. Provide regulator meeting following design conditions: inlet pressure 1 psi, outlet pressure 14-inch w.c. Capacity: 7834 scfh; "Model 122-12" by [Equimeter](#).
- D. 1½-inch pipe size, threaded connections, spring color blue for 5-inch w.c to 8½-inch w.c. outlet pressure regulation, diaphragm type regulator valve, straight body with internal relief vent. Inlet pressure 14 inches w.c., outlet pressure 8 inches w.c. Capacity: 634 scfh; "Model 243-12 -1" by [Equimeter](#).

2.6 master gas control valve and push button station **[use for schools]**

- A. Valve shall close by push button switch located where shown on the Drawings and by a solenoid valve in the gas piping.
- B. Solenoid valve shall be explosion proof, 2-way, packless, for normally closed operation. Valve shall be constructed of forged brass body with BUNA “N” seat, shall operate on 120 volt, single phase, with continuous duty molded Class “A” coil and shall be sized to pass the total design volume of cubic feet per hour of gas. Valve shall have manual reset.
- C. Valve shall be Model 8031B83 as manufactured by Automatic Switch Company.
- D. Provide a push button switch to activate the solenoid valve for installation by the electrical trade. All wiring shall be done by the electrical trade.

2.7 GAS METER

- A. Existing gas meter is to remain.

2.8 MISCELLANEOUS

- A. Vent Cap:
 - 1. ¾-inch to 1-inch pipe size: Aluminum body, built in drip edge for rain and painter protection, full size venting sized to compensate for effective screen opening, stainless steel screen; similar “Blo-Vent”, [UPSCO](#).
 - 2. 2-inch pipe size: 180° return bend steel end with 0.23 gauge stainless steel 12-inch x 12-inch mesh screen on outlet; “2-inch Return Bend” by [UPSCO](#).
 - 3. 1¼-inch to 4-inch pipe size: Iron body, 90° elbow with standard pipe thread with 12-inch x 12-inch mesh stainless steel screen on outlet; “Gas Vent” by [UPSCO](#).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping without pockets, with drips at low points, and with valves at each outlet.
- B. Use right and left nipples. Do not use bushings, unions and compression couplings.
- C. Gas piping within the building below grade is to be run in casings or conduits and to be properly vented at both ends.
- D. Where gas piping passes under roadways, route pipe through ductile iron sleeve extending 2-ft beyond roadway edge and having a minimum 1-inch (25mm) annulus clearance. Close ends of sleeve with foam or vermiculite to prevent earth filling of sleeve.
- E. Gas piping run in plenum spaces, regardless of size to be welded and shall be run in a two hour enclosure. No valves shall be installed in plenum spaces.
- F. Provide dielectric union between buried steel gas piping using listed isolation fitting.

3.2 APPLICATION

- A. Manual shutoff valves used on piping systems shall be as indicated for pipe sizes in Part 2.
- B. Over-Pressurization Relief Valve: Provide capacity in valve for full relief capacity when pressure regulator fails in widest position and include vent pipe rising 7 feet-0 inches above grade.

3.3 TESTING AND ADJUSTMENTS

- A. Test the gas piping system by means of an air pump and mercury gauge to a pressure equal to the maintenance of a column of mercury 12 inches high for a period of 10 minutes. Conduct the test in the presence of all required inspectors.
- B. Test under air pressure to 60 to 80 pounds per square-inch for minimum one hour duration. Measure natural gas system test pressure with a water manometer or an equivalent device

calibrated in increments not greater than 0.1-inch water column. System shall not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

- C. Submit all test reports, witnessed by City Inspectors, to the Project Manager.

END OF SECTION 226313

SECTION 230130.52 - EXISTING HVAC AIR DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes cleaning existing HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ACAC: American Council for Accredited Certification.
- B. AIHA-LAP: American Industrial Hygiene Association Lab Accreditation Program
- C. ASCS: Air systems cleaning specialist.
- D. CESB: Council of Engineering and Scientific Specialty Boards.
- E. CMI: Certified Microbial Investigator.
- F. CMC: Certified Microbial Consultant.
- G. CMR: Certified Microbial Remediator.
- H. CMRS: Certified Microbial Remediation Supervisor.
- I. EMLAP: Environmental Microbiology Laboratory Accreditation Program.
- J. IEP: Indoor Environmental Professional.
- K. IICRC: Institute of Inspection, Cleaning, and Restoration Certification.
- L. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data:

1. For an ASCS.
2. For an IEP.
3. For a CMR and a CMRS.

B. Field Quality-Control Reports:

1. Project's existing conditions.
2. Evaluations and recommendations, including cleanliness verification.
3. Strategies and procedures plan.

1.5 CLOSEOUT SUBMITTALS

- A. Post-Project report.

1.6 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA.

1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
2. Supervisor Qualifications: Certified

PART 2 - PRODUCTS

2.1 HVAC CLEANING AGENTS

- A. Description:

1. Formulated for each specific soiled coil condition that needs remedy.
2. Will not corrode or tarnish aluminum, copper, or other metals.

2.2 ANTIMICROBIAL SURFACE TREATMENT

- A. Description: Specific product selected shall be as recommended by the IEP based on the specific antimicrobial needs of the specific Project conditions.

1. Formulated to kill and inhibit growth of microorganisms.
2. EPA-registered for use in HVAC systems and for the specific application in which it will be used.
3. Have no residual action after drying, with zero VOC off-gassing.
4. OSHA compliant.
5. Treatment shall dry clear to allow continued visual observation of the treated surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR.
- C. Cleaning Plan: Prepare a written plan for air-distribution system cleaning that includes strategies and step-by-step procedures. At a minimum, include the following:
 - 1. Supervisor contact information.
 - 2. Work schedule, including location, times, and impact on occupied areas.
 - 3. Methods and materials planned for each HVAC component type.
 - 4. Required support from other trades.
 - 5. Equipment and material storage requirements.
 - 6. Exhaust equipment setup locations.
- D. Existing Conditions Report: Prepare a written report that documents existing conditions of the systems and equipment. Include documentation of existing conditions, including inspection results, photo images, laboratory results, and interpretations of the laboratory results by an IEP.
 - 1. Prepare written report listing conditions detrimental to performance of the Work.
- E. Proceed with work only after conditions detrimental to performance of the Work have been corrected.
- F. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- G. Comply with NADCA ACR, "Guidelines for Constructing Service Openings in HVAC Systems" Section.
- H. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning.

3.2 CLEANING

- A. Comply with NADCA ACR, including items identified as "recommended," "advised," and "suggested."
- B. Perform electrical lockout and tagout according to Owner's standards or authorities having jurisdiction.
- C. Remove non-adhered substances and deposits from within the HVAC system.

- D. Complete cleaning in accordance with Owner-Contractor agreed-upon scope of work.
- E. Systems and Components to Be Cleaned: All air-moving and -distribution equipment.
- F. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- G. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- H. Control odors and mist vapors during the cleaning and restoration process.
- I. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- J. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- K. Clean all air-distribution devices, registers, grilles, and diffusers.
- L. Clean non-adhered substance deposits according to NADCA ACR and the following:
 - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
 - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
 - 3. Clean evaporator coils, reheat coils, and other airstream components.
- M. Air-Distribution Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean air-distribution systems specified to remove all visible contaminants, so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- N. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- O. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the

HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

- a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
- b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials, such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR).
- c. Fibrous materials that become wet shall be discarded and replaced.

P. Coil Cleaning:

1. See NADCA ACR, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing coil cleaning verification.
2. Coil drain pans shall be subject to NADCA ACR, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
3. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
4. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations.
5. Rinse thoroughly with clean water to remove any latent residues.

Q. Application of Antimicrobial Treatment:

1. Apply antimicrobial agents and coatings if active fungal growth is determined by the IEP to be at Condition 2 or Condition 3 status according to IICRC S520, as analyzed by a laboratory, and with results interpreted by an IEP. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. Apply antimicrobial treatments and coatings after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Microbial remediation shall be performed by a qualified CMR and CMRS

3.3 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Surface-Cleaning Verification: Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Verification of Coil Cleaning: Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 - 1. Written documentation of the success of the cleaning.
 - 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 - 3. Surface comparison test results if required.
 - 4. Gravimetric analysis (nonporous surfaces only).
 - 5. System areas found to be damaged.

3.4 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts"
- C. Reseal fibrous-glass ducts. Comply with requirements in Section 233116 "Nonmetal Ducts."
- D. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- E. Replace damaged insulation according to Section 230713 "Duct Insulation."
- F. Ensure that closures do not hinder or alter airflow.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- H. Restore manual volume dampers and air-directional mechanical devices inside the system to their marked position on completion of cleaning.

- I. Measure air flows through air-distribution system.
- J. Measure static-pressure differential across each coil.

3.5 PROJECT CLOSEOUT

- A. Post-Project Report:
 - 1. Post-cleaning verification summary.
- B. Drawings:
 - 1. Deviations of existing system from Owner's record drawings.
 - 2. Location of service openings.

END OF SECTION 230130.52

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves without waterstop.
 - 2. Sleeves with waterstop.
 - 3. Grout.
 - 4. Silicone sealants.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, 0.0239-inch (0.6-mm) minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

2.2 SLEEVES WITH WATERSTOP

- A. Description: Manufactured **galvanized steel**, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.

2.3 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, T, NT: Single-component, pourable, movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade P, Uses T and NT.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
- D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with

requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using **grout to** seal space around outside of sleeves.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.4 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Interior Walls and Partitions:
 - a. Sleeves without waterstops.

ELMORE COUNTY
ADMINISTRATION REMODEL
MOUNTAIN HOME, ID

END OF SECTION 230517

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Warning tape.
 4. Pipe labels.
 5. Duct labels.
 6. Valve tags.
 7. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 2. Letter and Background Color: As indicated for specific application under Part 3.
 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

4. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 5. Fasteners: Stainless steel rivets or self-tapping screws.
 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F (71 deg C).
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch (0.12 mm).

- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F (70 deg C).
- F. Minimum Width: 2 inches (50 mm).

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **partially cover** circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:
 - 1. Duct size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution ducts. Arrows may be either integral with label or may be applied separately.

2.6 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.04-inch (1.0-mm) minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain, or S-hook.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

- A. Description: Preprinted accident-prevention tags of plasticized card stock.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum
 - 2. Fasteners: Brass grommet and wire
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: **Yellow background with black diagonal stripes**
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. (2 m) of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping as per the building's base building standard. Match paint color of existing systems.
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. (1 m) of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. (1 m) of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. (8 m) along each run. Reduce intervals to 10 ft. (3 m) in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F (52 deg C) or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
 - 1. Refrigerant Piping: **White letters on an ANSI Z535.1 safety-blue background.**
 - 2. Natural Gas Piping: **White letters on an ANSI Z535.1 yellow background**

3.6 INSTALLATION OF DUCT LABELS

- A. Install self-**adhesive** duct labels showing service and flow direction with permanent adhesive on all air ducts, existing and new.
 - 1. Provide labels in the following color codes:
 - a. For air supply ducts: White letters on blue background
 - b. For air return ducts: White letters on blue background
 - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background
- B. Locate label near each point where ducts enter into and exit from concealed spaces, passes through walls or floors, and at maximum intervals of 20 ft. (6 m) where exposed or are concealed by removable ceiling system.

3.7 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.
 - 1. Valve-Tag Size and Shape:
 - a. Refrigerant: 1-1/2 inches (38 mm) round
 - 2. Valve-Tag Colors:
 - a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.8 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Testing, Adjusting, and Balancing of Air Systems:
 - a. Constant-volume air systems.
 - 2. Testing, adjusting, and balancing of equipment.
 - 3. Testing, adjusting, and balancing of existing HVAC systems and equipment.
 - 4. Sound tests.
 - 5. Vibration tests.
 - 6. Duct leakage tests verification.
 - 7. Pipe leakage tests verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.
- G. UFAD: Underfloor air distribution.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units and verify that they are accessible and their controls are connected and functioning.
- K. Examine operating safety interlocks and controls on HVAC equipment.

- L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete and safeties are verified.
 - g. Automatic temperature-control systems are operational.
 - h. Ceilings are installed.
 - i. Windows and doors are installed.
 - j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "**National Standards for Total System Balance**" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation,"

Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in **inch-pound (IP)** units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Fans and ventilators.
 - 3. Terminal units.
 - 4. Unit heaters.
 - 5. Packaged air conditioners.
 - 6. Split-system air conditioners.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
 - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
 - 1. Measure airflow of submain and branch ducts.
 - 2. Adjust submain and branch duct volume dampers for specified airflow.
 - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
 - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 - 2. Measure inlets and outlets airflow.
 - 3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

3.8 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.9 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

3.10 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 1. Verify HVAC control system is operating within the design limitations.
 2. Confirm that the sequences of operation are in compliance with Contract Documents.

3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan and equipment with fan(s).
2. Measure and record flows, temperatures, and pressures of each piece of equipment in each hydronic system. Compare the values to design or nameplate information, where information is available.
3. Measure motor voltage and amperage. Compare the values to motor nameplate information.
4. Check the refrigerant charge.
5. Check the condition of filters.
6. Check the condition of coils.
7. Check the operation of the drain pan and condensate-drain trap.
8. Check bearings and other lubricated parts for proper lubrication.
9. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow rates rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.12 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm (47 L/s), within 10 cfm (4.7 L/s).
 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm (47 L/s), within 10 cfm (4.7 L/s).
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.

- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans performance forms, including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Heating coil, dry-bulb conditions.
 - e. Fan drive settings, including settings and percentage of maximum pitch diameter.
 - f. Variable-frequency controller settings for variable-air-volume systems.
 - g. Settings for pressure controller(s).
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.

5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Number, type, and size of filters.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan speed.
 - d. Inlet and discharge static pressure in inches wg (Pa).
 - e. For each filter bank, filter static-pressure differential in inches wg (Pa).
 - f. Cooling-coil static-pressure differential in inches wg (Pa).
 - g. Heating-coil static-pressure differential in inches wg (Pa).
 - h. List for each internal component with pressure-drop, static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressure drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).

- e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Refrigerant expansion valve and refrigerant types.
 - i. Refrigerant suction pressure in psig (kPa).
 - j. Refrigerant suction temperature in deg F (deg C).
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h (kW).
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches (mm), and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Entering-air temperature in deg F (deg C).
 - c. Leaving-air temperature in deg F (deg C).
 - d. Air temperature differential in deg F (deg C).
 - e. Entering-air static pressure in inches wg (Pa).
 - f. Leaving-air static pressure in inches wg (Pa).
 - g. Air static-pressure differential in inches wg (Pa).
 - h. Low-fire fuel input in Btu/h (kW).
 - i. High-fire fuel input in Btu/h (kW).
 - j. Manifold pressure in psig (kPa).
 - k. High-temperature-limit setting in deg F (deg C).
 - l. Operating set point in Btu/h (kW).
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h (kW).
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:

- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and speed.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan speed.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
 - a. System fan and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- J. Air-Terminal-Device Reports:
1. Unit Data:

- a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft. (sq. m).
2. Test Data (Indicated and Actual Values):
- a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).

K. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.15 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished 8 hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, concealed return located in unconditioned space.
 - 3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.4 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

- C. Coordinate installation and testing of heat tracing.

1.5 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule " articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F (232 deg C) in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F (1.7 deg C) and 250 deg F (121 deg C) for jacketed and between 35 deg F (1.7 deg C) and 450 deg F (232 deg C) for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.3 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Exterior Use: Suitable for outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 - 3. Color: White

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
 - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 2. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 - 3. Color: White.

2.5 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials are compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 4. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
 - 1. Materials are compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 - 4. Color: White.

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
 6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
 7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
 2. Color: White
- D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick polysurlyn.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick polysurlyn.
- E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with **stucco-embossed** aluminum-foil facing.

- F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
 2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
 3. Aluminum Finish: Embossed

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches (75 mm)
 2. Thickness: 11.5 mils (0.29 mm)
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
1. Width: 3 inches (75 mm)]
 2. Thickness: 6.5 mils (0.16 mm)
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches (50 mm)
 2. Thickness: 6 mils (0.15 mm)
 3. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches (50 mm)
 2. Thickness: 3.7 mils (0.093 mm)
 3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Aluminum: ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - b. Spindle: **Copper- or zinc-coated, low-carbon steel** fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

- b. Spindle: Copper- or zinc-coated, low-carbon steel fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel

2.10 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum in accordance with ASTM B209 (ASTM B209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
- 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge a 4 inches (100 mm) o.c.

- a. For below ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION

A. Comply with manufacturer's written installation instructions and ASTM C1710.

B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Square and Rectangular Ducts and Plenums:

1. Provide 1/4 inch (6.4 mm) more per side for a tight, compression fit.

2. Cut sheet insulation with the following dimensions:

a. Width of duct plus 1/4 inch (6.4 mm), one piece.

b. Height of duct plus 1/4 inch (6.4 mm), plus thickness of insulation, two pieces.

c. Width of duct plus 1/4 inch (6.4 mm), plus two times the thickness of insulation, one piece.

3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.

4. Insulation without self-adhering backing:

a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch (6.4 mm) where sheets will butt together.

b. Roll sheet down into position.

c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.

5. Insulation with self-adhering backing:

a. Peel back release paper in 6- to 8-inch (150- to 203-mm) increments and line up sheet.

b. Press firmly to activate adhesive.

- c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
 - d. Allow 1/4-inch (6.4-mm) overlap for compression at butt joints.
 - e. Apply adhesive at the butt joint to seal the two sheets together.
6. Insulate duct brackets following manufacturer's written installation instructions.

D. Circular Ducts:

1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
2. Cut the sheet to the required size.
3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

B. Comply with manufacturer's written installation instructions.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Comply with manufacturer's written installation instructions.

B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

C. Insulate duct access panels and doors to achieve same fire rating as duct.

D. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, supply air.
2. Indoor, return air located in unconditioned space.
3. Indoor, exhaust air located in unconditioned space.
4. Indoor, exhaust air between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Round and flat-oval, supply-air duct insulation is the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

B. Round and flat-oval, return-air duct insulation is the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

C. Round and flat-oval, exhaust-air duct insulation is the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

D. Rectangular, supply-air duct insulation is one of the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.
2. Glass-Fiber Board: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

E. Rectangular, return-air duct insulation is **one of** the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.
2. Glass-Fiber Board: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

F. Rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior is one of the following:

1. Glass-Fiber Blanket: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.
2. Glass-Fiber Board: 1-1/2 inches (38 mm) thick and 1.5 lb/cu. ft. (24 kg/cu. m) density.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

D. Ducts and Plenums, Exposed:

1. Stainless Steel, Type 304 Smooth 2B Finish 0.020 inch (0.51 mm) thick.

END OF SECTION 230713

SECTION 23 08 00 - COMMISSIONING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning mechanical systems, subsystems and equipment.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are noted below:
 - 1. Rooftop Units and the associated air distribution.
 - 2. Exhaust air systems and the associated fans and air distribution.
 - 3. HVAC Controls
 - 4. Terminal Units
 - 5. Split System Air Conditioners

1.3 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's Operation and Maintenance personnel in accordance with the requirements of Division 23, is required in cooperation with the Owner and the Commissioning Agent.

1.4 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Contractor will submit a list of submittals. The Commissioning Agent will review the list and identify submittals that require review. Contractor will deliver submittals identified by Commissioning Agent.
- B. The commissioning process requires Submittal review simultaneously with engineering review.

1.5 RELATED WORK

- C. Section 220800 – Commissioning of Plumbing Systems
- D. Section 260800 – Commissioning of Electrical Systems

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Manufacturer shall include required proprietary test equipment. Manufacturer shall furnish the test equipment, demonstrate its use, and assist the Commissioning Team in the commissioning process.

PART 3 - EXECUTION

3.1 SITE OBSERVATIONS

- A. Commissioning of the Building Mechanical Systems will require inspection of individual elements of the Mechanical construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Functional Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists through online Commissioning tool. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information submitted in the checklist is not accurate, the Commissioning Agent will mark the checklist "In Progress" and the Contractor will make the corrections and resubmit. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be marked "In Progress" and the Contractor will make the corrections and resubmit.

3.3 CONTRACTOR'S TESTS

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented and submitted for review. All testing shall be incorporated into the project schedule. Contractor shall give no less than 7 days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Functional Testing.

3.4 FUNCTIONAL TESTING

- A. The Commissioning Process includes Functional Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Functional Test procedures. The Contractor shall review and comment on the tests prior to approval. The Contractor shall include the required labor, materials, and test equipment identified in

the test procedure to perform the tests. The Commissioning Agent will witness and document the testing.

3.5 TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner and Commissioning Agent. Include competent, factory authorized personnel to deliver instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas. The instruction shall be scheduled in coordination with the Owner after submission and approval of formal training plans. Refer to Division 23 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Copper tube and fittings.
 2. Steel pipe and fittings.
 3. Valves and specialties.
 4. Refrigerants.

1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
1. Solenoid valves.
 2. Thermostatic expansion valves.
 3. Hot-gas bypass valves.
 4. Strainers.
 5. Filter dryers.
 6. Pressure-regulating valves.
 7. Mufflers.
- B. Product Data Submittals: For each product.
1. Submit data for each type of refrigerant piping, fitting, valve, piping specialty, and refrigerant.
- C. Delegated Design Submittals: For refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- D. Shop Drawings:
1. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
 2. Show interface and spatial relationships between piping and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding Certificates: For each welder performing shop or field welding on Project.
- B. Field Quality-Control Reports: For each field quality control test and inspection.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding, Brazing, and Fusing Qualifications."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.
- B. Prepare valves and specialties for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads and other end connections.
- C. Use the following precautions during storage:
 - 1. Maintain valve and specialty end protection.
 - 2. Store valves and specialties indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," for refrigerant piping size and layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- B. Comply with ASHRAE 15.

- C. Comply with ASME B31.5.
- D. Test Pressure for Refrigerant R-410A:
 - 1. Suction Tubing for Refrigeration and Air-Conditioning Applications Other than Heat Pumps: 300 psig (2068 kPa)
 - 2. Suction Tubing for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Tubing Lines: 535 psig (3689 kPa)

2.2 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B88, Type K or L (ASTM B88M, Type A or B)
- B. Wrought-Copper Fittings, Solder Joint: ASME B16.22.
- C. Wrought-Copper Fittings, Brazed Joint: ASME B16.50.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Solder Filler Metals: ASTM B32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- F. Brazing Filler Metals: AWS A5.8M/A5.8.
- G. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa)
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C)
- H. Copper-Tube, Pressure-Seal-Joint Fittings for Refrigerant Piping:
 - 1. Standard: UL 207; certified by UL for field installation. Certification as a UL-recognized component alone is unacceptable.
 - 2. Housing: Copper.
 - 3. O-Rings: HNBR compatible with specific refrigerant.
 - 4. Tools: Manufacturer's approved special tools.
 - 5. Minimum Rated Pressure: 700 psig (48 bar)

2.3 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless steel spring.
 3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig (3450 kPa)
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
 2. Packing: Molded stem, back seating, and replaceable under pressure.
 3. Operator: Rising stem.
 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
 5. Seal Cap: Forged-brass or valox hex cap.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Working Pressure Rating: 500 psig (3450 kPa)
 8. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. End Connections: Socket, union, threaded, or flanged.
 6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 7. Working Pressure Rating: 500 psig (3450 kPa)
 8. Maximum Operating Temperature: 275 deg F (135 deg C)
- D. Service Valves:
1. Body: Forged brass with brass cap, including key end to remove core.
 2. Core: Removable ball-type check valve with stainless steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig (3450 kPa)
 6. Maximum Operating Temperature: 275 deg F (135 deg C)
- E. Refrigerant Locking Caps:
1. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant-charging ports from unauthorized refrigerant access and leakage.
 2. Material: Brass, with protective shroud or sleeve.
 3. Refrigerant Identification: Color-coded, refrigerant specific based on AHRI Guideline N design.
 4. Special Tool: For installing and unlocking.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig (2760 kPa)
 6. Maximum Operating Temperature: 240 deg F (116 deg C).
- G. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa)
 6. Maximum Operating Temperature: 275 deg F (135 deg C)
- H. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color-coded to show moisture content in parts per million (ppm).
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3450 kPa)
 7. Maximum Operating Temperature: 240 deg F (116 deg C)
- I. Receivers: Comply with AHRI 495.
1. Comply with UL 207; listed and labeled by an NRTL.
 2. Body: Welded steel with corrosion-resistant coating.
 3. Tappings: Inlet, outlet, liquid-level indicator, and safety-relief valve.
 4. End Connections: Socket or threaded.
 5. Working Pressure Rating: 450 psig (3100 kPa)
 6. Maximum Operating Temperature: 250 deg F (121 deg C)

2.4 REFRIGERANTS

- A. R-410A, ASHRAE 34: Pentafluoroethane/Difluoromethane.
- B. R-454B (integral to packaged equipment)

PART 3 - EXECUTION

3.1 PIPING APPLICATION SCHEDULES

- A. Refrigerant: R-410A

- B. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with soldered joints.
- C. Suction, Hot-Gas, and Liquid Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, NPS 4 (DN 100) and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- D. Safety-Relief-Valve Discharge Tubing for Conventional Air-Conditioning (Cooling-Only) Applications, Copper: Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.
- E. Safety-Relief-Valve Discharge Piping for Conventional Air-Conditioning (Cooling-Only) Applications, Steel: Schedule 40, black steel and wrought-steel fittings with welded joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install **packed-angle** valves on inlet and outlet side of filter dryers.
- E. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install safety-relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside in accordance with ASHRAE 15.
- G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.

3. Compressor

- I. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- J. Install receivers sized to accommodate pump-down charge as required per the equipment manufacturer.
- K. Install flexible connectors at compressors.
- L. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping in accordance with ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230923 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- R. Identify refrigerant piping and valves in accordance with Section 230553 "Identification for HVAC Piping and Equipment."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- D. Brazed Joints: Construct joints in accordance with AWS BRH, "Brazing Handbook," Ch. 35, "Pipe and Tubing."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
 2. Use Type BA9 (cadmium-free silver) alloy for joining copper with bronze or steel.
- E. Threaded Joints: Thread steel pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and to restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- G. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 ft. (6 m) long.
 2. Roller hangers and spring hangers for individual horizontal runs 20 ft. (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 ft. (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for **copper tubing** with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches (300 mm) of each fitting.
- E. Support vertical runs of **copper tubing** to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System must maintain test pressure at the manifold gauge throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- #### A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- #### B. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- #### C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves but not bypass valves that are used for other purposes.

5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

1.2 DEFINITIONS

- ##### A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.

2. For ducts exposed to weather, construct of **Type 304** stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. For ducts with longest side less than 36 inches (914 mm), select joint types in accordance with Figure 2-1.
 2. For ducts with longest side 36 inches (914 mm) or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 2. For ducts exposed to weather, construct of Type 304 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- B. Source Limitations: Obtain single-wall round ducts and fittings from single manufacturer.
- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-

support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- E. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90 (Z180)
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90 (Z180)
 - 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
 - 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- E. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- G. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating is to be applied to the exterior surface.
 - 2. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound is to have a hardness of 2H, minimum, when tested in accordance with ASTM D3363.
 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
 5. Shop-Applied Coating Color: **Black**.
 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- H. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- I. Tie Rods: Galvanized steel, 1/4-inch- (6-mm-) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch- (10-mm-) minimum diameter for lengths longer than 36 inches (900 mm).

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Source Limitations: Obtain fibrous-glass duct liner from single manufacturer.
 2. Maximum Thermal Conductivity:
 - a. Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound is to be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 4. Water Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
 5. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) in diameter.
- B. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches (102 mm).
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10 inch wg (2500 Pa), positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and is to be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

D. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.

E. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- M. Elbows: Use long-radius elbows wherever they fit.
 - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
 - 1. Ductwork is to be Type 304 stainless steel.
 - 2. Ductwork is to be galvanized steel.
 - a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting."

3. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2,

"Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. 10 percent of total installed duct area, new and existing.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.

5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give 7 days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."

C. Use duct cleaning methodology as indicated in NADCA ACR.

D. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

E. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

F. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

G. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply Ducts:

1. Ducts downstream of VVT Terminal Units:
 - a. Pressure Class: Positive 2- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A
 - c. SMACNA Leakage Class for Rectangular: 6
 - d. SMACNA Leakage Class for Round and Flat Oval: 6
2. Ducts Upstream of VVT Terminal Units and Downstream of RTU's:
 - a. Pressure Class: Positive 3- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A
 - c. SMACNA Leakage Class for Rectangular: 4
 - d. SMACNA Leakage Class for Round and Flat Oval: 4
3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 3- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A
 - c. SMACNA Leakage Class for Rectangular: 4
 - d. SMACNA Leakage Class for Round and Flat Oval: 4

C. Return Ducts:

1. Ducts Connected to Rooftop Units:
 - a. Pressure Class: Negative 3- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A
 - c. SMACNA Leakage Class for Rectangular: 4
 - d. SMACNA Leakage Class for Round and Flat Oval: 4
2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Negative 3- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A
 - c. SMACNA Leakage Class for Rectangular: 4
 - d. SMACNA Leakage Class for Round and Flat Oval: 4

D. Exhaust Ducts:

1. Ducts Connected to Exhaust Fans Air:
 - a. Pressure Class: Negative 2- (500) inch wg (Pa).
 - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 6
 - d. SMACNA Leakage Class for Round and Flat Oval: 6

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel

F. Liner:

1. Supply and Return Air Ductwork within 20 linear feet of a Fan: Fibrous glass, Type I 1 (25) inch (mm) thick.

G. Elbow Configuration:

1. Rectangular Duct - Requirements for Different Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Conical spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Control Dampers
 - 3. Fire dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Remote damper operators.
 - 7. Duct-mounted access doors.
 - 8. Duct access panel assemblies.
 - 9. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Performance:
 - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. (203 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.
 - 2. Construction:
 - a. Linkage out of airstream.
 - b. Suitable for horizontal or vertical airflow applications.
 - 3. Frames:
 - a. Hat-shaped, 16-gauge- (1.6-mm-) thick, galvanized sheet steel
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.

- b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel; 16 gauge (1.6 mm) thick.
 5. Blade Axles: Galvanized steel.
 6. Bearings:
 - a. Molded synthetic
 - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
 7. Tie Bars and Brackets: Galvanized steel.
 8. Locking device to hold damper blades in a fixed position without vibration.
- B. Jackshaft:
 1. Size: 0.5-inch (13-mm) diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. Damper Hardware:
 1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

- A. General Requirements:
 1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
 2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
- B. Performance:
 1. AMCA Certification: Test and rate in accordance with AMCA 511.
 2. Leakage:
 - a. Class I: Leakage shall not exceed 4 cfm/sq. ft. (20 L/s per sq. m) against 1-inch wg (250-Pa) differential static pressure.

3. Pressure Drop: 0.05 inch wg (12.5 Pa) at 1500 fpm (7.6 m/s) across a 24-by-24-inch (600-by-600-mm) damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm (15 m/s)
5. Temperature: Minus 25 to plus 180 deg F (Minus 32 to plus 83 deg C).
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

C. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
 - a. Hat, U, or angle shaped.
 - b. 16-gauge- (1.6-mm-) thick, galvanized sheet steel
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
 - a. Multiple blade with maximum blade width of 6 inches (150 mm)
 - b. Opposed-blade design.
 - c. Galvanized steel
 - d. 14-gauge- (1.9-mm-) thick air foil dual skin.
5. Blade Edging Seals:
 - a. Inflatable seal blade edging, or replaceable rubber seals.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch (13-mm) diameter; galvanized steel.
8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
 - a. Molded synthetic
 - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

D. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Two position
 - a. Sufficient motor torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
 - b. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:
 - a. Temperature: Minus 40 to plus 130 deg F ((Minus 40 to plus 55 deg C)).
 - b. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

E. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 24 V, 60 Hz

2.4 FIRE DAMPERS

- A. Type: **Static** rated and labeled in accordance with UL 555 by an NRTL.
- B. Fire Rating: 3 hours.
- C. Frame: Curtain type with blades inside airstream fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.
- D. Mounting Sleeve: Factory- or field-installed, **galvanized sheet** steel; gauge in accordance with UL listing.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blades: Roll-formed **galvanized sheet steel** Material gauge is to be in accordance with UL listing.
- G. Heat-Responsive Device:
 1. Replaceable, 165 deg F (74 deg C) rated, fusible links.
 2. Replaceable link and switch package, factory installed, 165 deg F (74 deg C) rated.

2.5 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vaness and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

C. Vane Construction:

1. Single wall.

2.6 REMOTE DAMPER OPERATORS

A. Description: Cable system designed for remote manual damper adjustment.

B. Tubing: Copper

C. Cable: Steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Stainless steel.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.

b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

c. 24-gauge- (0.70-mm-) thick galvanized steel door panel.

d. Vision panel.

e. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

f. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

a. 24-gauge- (0.70-mm-) thick galvanized steel or 0.032-inch- (0.81-mm-) thick aluminum frame.

3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.

- b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.

2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.9 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90 (Z275).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

- C. Install **control** dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install fire dampers in accordance with UL listing.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 25-ft. spacing.
 - 8. Upstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. For grease ducts, install at locations and spacing as required by NFPA 96.
 - 11. Control devices requiring inspection.
 - 12. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).

4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5 inches wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Install duct test holes where required for testing and balancing purposes.
- P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For flexible ducts.
 - 1. Include plans showing locations and mounting and attachment details.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

- D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

- A. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; **polyethylene** vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
 - 4. Insulation R-Value: Comply with ASHRAE/IES 90.1

2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
- B. Non-Clamp Connectors: **Adhesive plus sheet metal screws.**

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect diffusers to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
- D. Connect flexible ducts to metal ducts with **draw bands**
- E. Install duct test holes where required for testing and balancing purposes.
- F. Installation:
 - 1. Install ducts fully extended.
 - 2. Do not bend ducts across sharp corners.
 - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
 - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
 - 5. Install flexible ducts in a direct line, without sags, twists, or turns.

G. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches (38 mm) wide or wider and spaced a maximum of 48 inches (1200 mm) apart. Maximum centerline sag between supports shall not exceed 1/2 inch (13 mm) per 12 inches (300 mm).
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches (1800 mm) o.c.

END OF SECTION 233346

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Centrifugal ventilators - roof downblast.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified fan sound-power ratings.
 - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 6. Material thickness and finishes, including color charts.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Prefabricated roof curbs.
 - 9. Fan speed controllers.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Design Calculations: Calculate requirements for selecting vibration isolators

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Product Certificates: Submit certificates that specified equipment will withstand required wind forces, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Unusual Service Conditions
 - 1. Base fan-performance ratings on the following:
 - a. Ambient Temperature: 99.8°F DB
 - b. Altitude: 3000 FT above sea level.
 - c. Humidity: 62.8°F WB
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.
- D. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- F. Capacities and Characteristics: Refer to mechanical schedules in drawings.

2.2 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

- A. Housing: Downblast; removable spun aluminum; square, one-piece aluminum base with venturi inlet cone.
- B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades
- C. Accessories:
 - 1. Variable-Frequency Motor Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted **inside** fan housing, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
 - 4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
 - 5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.
 - 6. Mounting Pedestal: Galvanized steel with removable access panel.
- D. Prefabricated Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange] [Built-in cant and mounting flange
 - 2. Overall Height: 12 inches (300 mm)
 - 3. Hinged sub-base to provide access to damper or as cleanout for grease applications.
 - 4. Metal Liner: Galvanized steel.
 - 5. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

- A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.
- B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.
- C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.
- D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 - 1. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
 - 2. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 STARTUP SERVICE:

- A. **Perform** startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
 - 2. Verify that shipping, blocking, and bracing are removed.
 - 3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Lubricate bearings.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

- A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections
 - 1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safeties.
 - 3. Fans and components will be considered defective if they do not pass tests and inspections.
 - 4. Prepare test and inspection reports.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

SECTION 233713.13 - AIR DIFFUSERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
 - 3. Louver face diffusers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.
- C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.
- D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- A. Refer to Mechanical Air Outlets and Inlets Schedule for additional specifications.
- B. Material: Steel
- C. Finish: Baked enamel, white
- D. Face Size: As Scheduled.
- E. Face Style: Three cone
- F. Mounting: As required to be compatible with the architectural ceiling. Refer to architectural plans. Where in rigid ceilings, use concealed mounting.
- G. Pattern: Adjustable.
- H. Dampers: None
- I. Accessories:
 1. Equalizing grid.
 2. Plaster ring.
 3. Safety chain.
 4. Wire guard.
 5. Sectorizing baffles.
 6. Operating rod extension.

2.2 PERFORATED DIFFUSERS

- A. Material: Steel backpan and pattern controllers, with **steel** face.
- B. Finish: Baked enamel, white.
- C. Face Size: As Scheduled

- D. Duct Inlet: As Scheduled.
- E. Face Style: Flush
- F. Mounting: As required to be compatible with the architectural ceiling. Refer to architectural plans. Where in rigid ceilings, use concealed mounting
- G. Pattern Controller: Four louvered deflector patches.
- H. Dampers: None.
- I. Accessories:
 - 1. Equalizing grid.
 - 2. Plaster ring.
 - 3. Safety chain.
 - 4. Wire guard.
 - 5. Sectorizing baffles.
 - 6. Operating rod extension.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,

locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13

SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed face registers and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.
- C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.
- D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

- A. Fixed Face Register: Refer to Mechanical Schedule Sheet for additional specifications
1. Material: Steel
 2. Finish: Baked enamel, white.
 3. Face Blade Arrangement: Horizontal spaced 1/2 inch apart.
 4. Core Construction: Integral
 5. Frame: 1 inch (25 mm) wide.
 6. Mounting: As required to be compatible with the architectural ceiling. Refer to architectural plans. Where in rigid ceilings, use concealed mounting Damper Type.

2.2 GRILLES

- A. Fixed Face Grille: Refer to Mechanical Schedule Sheet for additional specifications
1. Material: Steel
 2. Finish: Baked enamel, white
 3. Face Blade Arrangement: Horizontal spaced 1/2 inch apart.
 4. Core Construction: Integral.
 5. Frame: 1 inch (25 mm) wide.
 6. Mounting: As required to be compatible with the architectural ceiling. Refer to architectural plans. Where in rigid ceilings, use concealed mounting

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

SECTION 237416.11 - PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components:
1. RTU-01 and all associated components
 2. RTU-02 and all associated components
 3. RTU-03 and all associated components
 4. RTU-04 and all associated components

1.2 DEFINITIONS

- A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, small-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.3 ACTION SUBMITTALS

- A. Product Data: For each RTU.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
 3. Include unit dimensions and weight.
 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
 5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
 6. Include certified coil-performance ratings with system operating conditions indicated.
 7. Include filters with performance characteristics.
 8. Include gas furnaces with performance characteristics.
 9. Include dampers, including housings, linkages, and operators.
- B. Shop Drawings: For each packaged, small-capacity, rooftop air-conditioning unit.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Sample Warranty: For manufacturer's warranty.
- C. Source quality-control reports.
- D. System startup reports.
- E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Filters: one set(s) of filters for each unit.
 2. Gaskets: one set(s) for each access door.

1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of packaged, small-capacity, rooftop air-conditioning unit that fail in materials or workmanship within specified warranty period.
 1. Warranty Period begins from date of Substantial Completion.
 2. 1 Year Parts
 3. 5 Years Compressor Parts
 4. 10-Year Heat Exchanger

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 Compliance: For refrigeration system safety.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance: Comply with UL 1995.

2.2 CAPACITIES AND CHARACTERISTICS

- A. Refer to mechanical schedules in drawings for capacities and characteristics.

2.3 RTU-01 Thru 04 - PACKAGED, SMALL-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

- A. Equipment Insulation
 - 1. Evaporator fan compartment:
 - a. Interior cabinet surfaces shall be insulated with a minimum 1/2 in. thick, minimum 1-1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
 - b. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
 - 2. Gas Heat Compartment:
 - a. Aluminum foil-faced fiberglass insulation shall be used.
 - b. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
- B. Instrumentation and control devices for HVAC
 - 1. Sensors and Transmitters
 - a. Thermostats
 - 1) Thermostat must:
 - a) energize both "W" and "G" when calling for heat.

- b) have capability to energize 1 or 2 stages of cooling, and 2 different stages of heating.
- c) include capability for occupancy scheduling.

C. Direct Digital Control system for HVAC

- 1. SystemVu™ intelligent integrated Direct Digital Control (DDC) shall provide:
 - a. Integrated unit operation for comfort cooling, heating ventilation as well as all monitoring, recording and reporting capabilities. Controller shall also provide diagnostics and alarms of abnormal unit operation through the controller.
 - b. Controller shall have an intuitive user display and be able to be used in a standalone operation
 - c. Quick Unit Status LEDs of: Run — meaning all systems are go, ALERT — that indicates there is currently a non-critical issue with the unit, like filters need to be replaced and FAULT — that indicates the unit has a critical issue and will possibly shut down.
 - d. Six large navigation keys for easy access. Navigation keys shall consist of: TEST, BACK, ENTER, and MENU along with UP and DOWN arrows.
 - e. Full back lit user display with 4 line by 30 character text capabilities. Display menu shall be designed to provide guided major menus and sub menus main menus provided below:
 - 1) Shutdown Unit
 - 2) Run Status
 - 3) Settings
 - 4) Alerts/Faults
 - 5) Service
 - 6) Inputs
 - 7) Outputs
 - 8) USB
 - f. The capability for standalone operation with conventional thermostat/sensor or use with building automation systems (BAS) of Carrier i-Vu®, BACnet, and Carrier Comfort Network® (CCN) systems. No special modules or boards are required for these capabilities. Has the capability to work with Equipment Touch™ and System Touch™ devices and ZS Sensors.
 - g. The ability to read refrigerant pressures at display or via BAS network of; Discharge Pressure and Suction Pressure. The need for traditional refrigerant gauges is not required.
 - h. USB Data Port for flash drive interaction. This will allow the transfer of data for uploads, downloads, perform software upgrades, back-up and restore data and file transfer data such as component number of starts and run hours.
 - i. Reverse Rotation Protection of compressors if field 3-phase wiring is misapplied.
 - j. Provide Service Capabilities of:
 - 1) Auto run test
 - 2) Manual run test
 - 3) Component run hours and starts
 - 4) Commissioning reports
 - 5) Data logging
 - 6) Alarm history

- k. Economizer control and diagnostics. Set up economizer operation, receive feedback from actuator. Also meets the most recent versions of ASHRAE 90.1 and IECC Fault Detection and Diagnostic (FDD) requirements.
- l. Unit cooling operation down to 40°F (4°C).
- m. Controller shall have easy access connections around the controller perimeter area and consist of Mate-N-Lok, terminal block and RJ style modular jack connections.
- n. 365 day real time clock, 20 holiday schedules along with occupied and unoccupied scheduling.
- o. Auto-Recognition for easy installation and -commissioning of devices like economizers, space sensors etc.
- p. A 5°F temperature difference between cooling and heating set points to meet the latest ASHRAE 90.1 Energy Standard.
- q. Contain return air sensor, supply air sensor and outdoor air sensor to help monitor and provide data for the unit comfort operation, diagnostic and alarms.
- r. Use of Carrier's field accessory Equipment Touch and System Touch devices.
- s. Supply Air Tempering control operates the gas or electric heat to maintain a minimum supply air temperature during conditions where very cold outdoor air causes the supply air temperature to fall below the configured Supply Air Tempering Setpoint. This occurs during periods where DCV is active and increasing the amount of outdoor air or in cases where the system is operating at very low airflow and the calculated economizer position has increased to maintain a constant ventilation rate.
- t. Demand limiting in SystemVu™ is achieved through set point expansion. The systems heating and cooling set points are expanded in steps or levels. The degree to which the set points may be expanded is defined by the 6 demand level offsets and the 2 commanded demand limit levels.
- u. 3-year limited part warranty.

D. Electric and Electronic Control System for HVAC

1. General

- a. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
- b. Shall utilize color-coded wiring.
- c. Shall include a Unit Control Board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches. Controller shall also provide an intuitive means to adjust the indoor fan speed through a simple switch and pot adjustment design.
- d. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
- e. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.

2. Safeties:

- a. Compressor over-temperature, over-current. High internal pressure differential.
- b. Low pressure switch.

- 1) Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
- c. High pressure switch.
 - 1) High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
- d. Mixed Air Auto Reset Temperature Switch:
 - 1) All cooling units contain a low return air (or mixed air - depending on unit configuration) temperature switch for compressor protection. The switch prevents compressor operation at mixed air temperatures below 60F to ensure long term reliability but allows continued fan and economizer operation (if installed). The switch will automatically reset when the return/mixed air temperature warms above 65F and will allow compressor operation to continue
- e. Automatic reset, motor thermal overload protector.
- f. Heating section shall be provided with the -following minimum protections:
 - 1) High temperature limit switches.
 - 2) Induced draft motor pressure switch
 - 3) Flame rollout switch.
 - 4) Flame proving controls.
- g. Refrigerant Leak Dissipation System (Electromechanical)
 - 1) Leak dissipation system shall consist of control board and A2L sensor certified to UL 60335-2-40
 - 2) System shall be designed for the life of the unit
 - 3) Dissipation system shall be automatic, ship prewired, and require no additional field connections to thermostat to function
 - 4) Refrigerant leak sensor shall be installed in UL certified location and orientation. Sensor shall be self-correcting and resettable. Single use refrigerant leak sensor shall not be permitted
 - 5) Factory installed dissipation controller shall use onboard microprocessor and include:
 - a) Automatic reset after a dissipation event has occurred
 - b) Onboard LED with flash code to indicate current unit status and hardware failures
 - c) Depressible “Test” button to allow for a system test and recall/reset of leak detection history
 - d) 24V dry contact alarm terminal to allow for external notification of leak detection
 - 6) Dissipation control board shall be accessible via normal maintenance locations and LED shall be visible
 - 7) Dissipation system shall “Fail Safe” per UL requirements
 - 8) Dissipation shall allow smoke and building fire systems to override in case of event
- h. Refrigerant Leak Dissipation System (SystemVu)
 - 1) Leak dissipation system shall consist of control board and A2L sensor certified to UL 60335-2-40, integrated with SystemVu controller

- 2) System shall be designed for the life of the unit
- 3) Dissipation system shall be automatic, ship prewired, and require no additional field connections to function
- 4) Refrigerant leak sensor shall be installed in UL certified location and orientation. Sensor shall be self-correcting and resettable. Single use refrigerant leak sensor shall not be permitted
- 5) Factory installed dissipation system shall use onboard microprocessor and include:
 - a) Automatic leak detection and dissipation algorithm
 - b) Automatic reset after a dissipation event has occurred
 - c) Onboard LED with flash code to indicate current unit status and hardware failures
 - d) Depressible "Test" button to allow for a system test and recall/reset of leak detection history
 - e) 24V dry contact alarm terminal on dissipation control board to allow for external notification of leak detection
 - f) Ability to notify BAS system of dissipation event via readable alarm point through SystemVu
 - g) Recallable dissipation alarm history on SystemVu controller
- 6) Dissipation control board shall be accessible via normal maintenance locations and LED shall be visible
- 7) Dissipation system shall "Fail Safe" per UL requirements
- 8) Dissipation shall allow smoke and building fire systems to override in case of event

E. Panel Air Filters

1. Standard filter section:
 - a. Shall consist of factory installed, low velocity, disposable 2 in. thick fiberglass filters of -commercially available sizes.
 - b. Unit shall use only one filter size. Multiple sizes are not acceptable.
 - c. Filters shall be accessible through an access panel with "no-tool" removal as described in the unit cabinet section of this specification.

F. General

1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
2. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
3. Unit shall use Puron Advance™ (R-454B) refrigerant.
4. Unit shall be installed in accordance with the manufacturer's instructions .
5. Unit must be selected and installed in compliance with local, state, and federal codes.

G. Quality Assurance:

1. Unit meets DOE and ASHRAE 90.1 minimum efficiency requirements.
2. Unit shall be rated in accordance with AHRI Standards 340/360.
3. Unit shall be designed to conform to ASHRAE 15.

4. Unit shall be UL-tested and certified in accordance with ANSI Z21.47 Standards and UL-listed
5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
6. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001:2015.
7. Roof curb shall be designed to conform to NRCA Standards. Where existing roof curb is suitable for re-use, reuse existing roof curb.
8. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
9. Unit shall be designed in accordance with UL Standard 60335-1 and 60335-2-40, including testing to withstand rain. Unit shall be IPX4 rated.
10. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
11. Unit shall be tested to assurance level 1, ASTM D4169 to ensure shipping reliability.

H. Delivery, Storage, and Handling:

1. Unit shall be stored and handled per manufacturer's recommendations.
2. Lifted by crane requires either shipping top panel or spreader bars.
3. Unit shall only be stored or positioned in the upright position.

I. Operating Characteristics:

1. Unit shall be capable of starting and running at 115°F (46°C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 340/360 at ±10% voltage.
2. Compressor with standard controls shall be capable of operation down to 40°F (4°C), ambient outdoor temperatures.
3. Unit shall discharge supply air vertically as shown on contract drawings.
4. Unit shall be factory configured for vertical -supply and return configurations.
5. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required
6. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

J. Electrical Requirements:

1. Main power supply voltage, phase, and frequency must match those required by the manufacturer and listed in the mechanical equipment schedules.

K. Unit Cabinet:

1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a prepainted baked enamel finish on all externally exposed surfaces.
2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60°F/16°C): 60, Hardness: H-2H Pencil hardness.
3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2 in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the heat compartment.

4. Base of unit shall have a minimum of 4 locations for thru-the-base gas and electrical connections (factory-installed or field-installed), standard.
- L. Base Rail:
1. Unit shall have base rails on a minimum of 2 sides.
 2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
 3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
 4. Base rail shall be a minimum of 16 gauge thickness.
- M. Condensate pan and connections:
1. Shall be a sloped condensate drain pan made of a corrosion resistant material.
 2. Shall comply with ASHRAE Standard 62.
 3. Shall use a 3/4 in. 14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer's recommendations.
- N. Top panel:
1. Shall be a single piece top panel on 08-14 models and two piece on 16 size models.
- O. Gas Connections:
1. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit (horizontal plane).
 2. Thru-the-base capability
 - a. Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
 - b. Optional, factory approved, water-tight connection method must be used for thru-the-base gas connections.
 - c. No basepan penetration, other than those authorized by the manufacturer, is permitted.
- P. Electrical Connections:
1. All unit power wiring shall enter unit cabinet at a single, factory prepared, knockout location.
 2. Thru-the-base capability
 - a. Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
 - b. Optional, factory approved, water-tight connection method must be used for thru-the-base electrical connections.
 - c. No basepan penetration, other than those authorized by the manufacturer, is permitted.
- Q. Component access panels (standard):
1. Cabinet panels shall be easily removable for servicing.
 2. Unit shall have one factory installed, tool-less, removable, filter access panel.
 3. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have molded composite handles.
 4. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.

5. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.
6. Collars shall be removable and easily replaceable using manufacturer recommended parts.

R. Gas Heat:

1. General:
 - a. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
 - b. Shall incorporate a direct-spark ignition -system and redundant main gas valve.
 - c. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
 - a. IGC board shall notify users of fault using an LED (light-emitting diode).
 - b. The LED shall be visible without removing the control box access panel.
 - c. IGC board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch.
 - d. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.
3. Standard Heat Exchanger construction:
 - a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.
 - b. Burners shall be of the in-shot type constructed of aluminum-coated steel.
 - c. Burners shall incorporate orifices for rated heat output up to 2000 ft (610 m) elevation. Additional accessory kits may be required for applications above 2000 ft (610 m) elevation, depending on local gas supply conditions.
 - d. Each heat exchanger tube shall contain multiple dimples for increased heating effective-ness.
4. Induced draft combustion motor and blower
 - a. Shall be a direct-drive, single inlet, forward-curved centrifugal type.
 - b. Shall be made from steel with a corrosion resistant finish.
 - c. Shall have permanently lubricated sealed bearings.
 - d. Shall have inherent thermal overload protection.
 - e. Shall have an automatic reset feature.

S. Coils:

1. Standard Aluminum Fin-Copper Tube Coils:
 - a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally helical grooved copper tubes with all joints brazed.
 - b. Evaporator coils shall be leak tested to 150 psig, pressure tested to 450 psig, and qualified to UL 60335-2-40 burst test at 1775 psig.
 - c. Condenser coils shall be leak tested to 150 psig, pressure tested to 650 psig, and qualified to UL 60335-2-40 burst test at 1980 psig.

T. Refrigerant Components:

1. Refrigerant circuit shall include the following control, safety, and maintenance features:
 - a. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
 - b. Refrigerant filter drier — Solid core design with pre and post filter service gauge connections for filter diagnostics and maintenance
 - c. Service gauge connections on suction and discharge lines.
 - d. Pressure gauge access through a specially designed access port in the unit.
2. There shall be gauge line access port in the skin of the rooftop
 - a. The gauge access port shall enable maintenance personnel to route their pressure gauge lines.
 - b. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
3. Compressors:
 - a. Unit shall use tandem scroll compressor assembly on a single refrigeration circuit with two stages of cooling for efficient comfort cooling operation.
 - b. Evaporator coils shall be a full active design to help better control latent removal and minimize unconditioned bypass air.
 - c. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
 - d. Compressors shall be internally protected from high discharge temperature conditions.
 - e. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
 - f. Compressor shall be factory-mounted on rubber grommets.
 - g. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
 - h. Crankcase heaters shall not be required for normal operating range, unless required by the manufacturer due to refrigerant charge limits.
4. Filter Section:
 - a. Filters access is specified in the unit cabinet section of this specification.
 - b. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
 - c. Shall consist of factory installed, low velocity, throw-away 2 in. thick fiberglass filters.
 - d. Filters shall be standard, commercially available sizes.
 - e. Only one size filter per unit is allowed.

U. Evaporator Fan and Motor with EcoBlue™ Technology:

1. Direct Drive Evaporator fan motor:
 - a. Shall be an ECM motor design.
 - b. Shall be direct drive design for all static options.
 - c. Shall have permanently lubricated bearings.
 - d. Shall have inherent automatic-reset thermal overload protection.
 - e. Shall have slow ramp up to speed capabilities.

- f. Shall require no fan/motor belts for operation, adjustments and or initial fan speed setup.
 - g. Fan DC voltage set up on Unit Control Board shall eliminate the need of removal of blower access door, required on conventional belt drive systems.
 - h. Shall be internally protected from electrical phase reversal.
2. Evaporator Fan:
- a. Speed shall be easily set with dedicated selection switch and adjustment pot on unit control board or through SystemVu™ controller.
 - b. Shall provide 2 stage cooling capacity control, the indoor fan speed is automatically controlled to meet the code-compliant <66% low fan speed and 100% at full fan speed operation.
 - c. Blower fan shall be a Vane Axial fan design with fan assembly secured directly to ECM motor. Additional shafts, belts, pulleys/sheaves, and bearing blocks to drive fan shall not be permitted or necessary.
 - d. Additional variable frequency drive to control fan motor speed shall not be permitted or necessary. All speed control electronics must be onboard fan motor assembly.
 - e. Shall be constructed of a high impact composite material for stator, rotor, and air inlet casing.
 - f. Shall be a patented / pending design with a corrosion resistant material.
 - g. Fan assembly design shall be integrated to fan deck, dynamically balanced, and require no additional vibration isolation for normal operation.
 - h. Shall have slow ramp up to speed capabilities to help reduce sound and comfort issues typically associated with single speed belt drive systems.
 - i. Shall be a slide out design with removal of a few support brackets.
3. Shall include an easily accessible Unit Control Board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches. Controller shall also provide an intuitive means to adjust the indoor fan speed through a simple switch and pot adjustment design.

V. Condenser Fans and Motors:

- 1. Condenser fan motors:
 - a. Shall be a totally enclosed motor.
 - b. Shall use permanently lubricated bearings.
 - c. Shall have inherent thermal overload protection with an automatic reset feature.
 - d. Shall use a shaft-down design on all sizes.
- 2. Condenser Fans:
 - a. Shall be a direct-driven propeller type fan.
 - b. Shall have galvalum blades riveted to steel spider that have corrosion-resistant properties and shall be dynamically balanced.

W. Special Features Options and Accessories:

- 1. Integrated EconomizerONE and EconoMiSer® 2 low leak rate models.
 - a. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.

- b. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory installed option.
- c. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
- d. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.
- e. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
- f. Low leak rate shall be equipped with dampers not to exceed 2% leakage at 1 in. wg pressure differential.
- g. Economizer controller on EconomizerONE models shall be the Siemens POL224 that provides:
 - 1) Combined minimum and DCV maximum damper position potentiometers with compressor staging relay.
 - 2) Optional configuration via WLAN stick and Siemens Climatix™ smartphone app for easy setup.
 - 3) Functions with solid-state analog enthalpy or dry bulb changeover control sensing.
 - 4) LED indication for free cooling, sensor, and damper operation.
 - 5) One-line LCD interface screen for setup, configuration and troubleshooting.
 - 6) On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, per California Title 24, ASHRAE 90.1 and IECC®.
 - 7) Sensor failure loss of communication identification.
 - 8) Capabilities for use with multiple-speed or single speed indoor fan systems.
 - 9) Digital sensors: Dry bulb and Enthalpy.
- h. Economizer controller on EconoMi\$er® 2 models with SystemVu controllers shall be a 4-20mA design controlled directly by the controller. SystemVu controllers meet California Title 24, ASHRAE 90.1 and IECC Fault Detection and Diagnostic (FDD) requirements.
- i. Shall be capable of introducing up to 100% outdoor air.
- j. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements.
- k. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
- l. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory installed only. Outdoor air sensor set point shall be adjustable and shall range from 40°F to 100°F (4°C to 38°C).
- m. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
- n. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
- o. Dampers shall be completely closed when the unit is in the unoccupied mode.
- p. Economizer controller shall accept a 0 to 10 vdc CO 2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.

- q. Compressor lockout temperature on POL224 control is adjustable from -45°F to 80°F (-43 to 26°C), set at a factory default of 32°F (0°C).
- r. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
- s. Contains LED indication for free cooling, sensor, and damper operation.
- 2. Integrated EconomizerONE and EconoMiSer® 2 Ultra Low Leak rate models.
 - a. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
 - b. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory-installed option.
 - c. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
 - d. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.
 - e. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
 - f. Ultra Low Leak design meets California Title 24 section 140.4 and ASHRAE 90.1 requirements for 4 cfm per sq ft on the outside air dampers and 10 cfm per sq ft on the return dampers.
 - g. Economizer controller on EconomizerONE models shall be the Siemens POL224 that provides:
 - 1) One-line LCD interface screen for setup, configuration and troubleshooting.
 - 2) Optional configuration via WLAN stick and Siemens Climatix™ smartphone app for easy setup.
 - 3) On-board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is not operating properly, per California Title 24, ASHRAE 90.1 and IECC.
 - 4) Sensor failure loss of communication identification.
 - 5) Capabilities for use with multiple-speed indoor fan systems.
 - 6) Digital sensors: Dry bulb and Enthalpy.
 - h. Economizer controller on EconoMiSer® 2 models with SystemVu controls shall be a 4 to 20mA design controlled directly by the controller. SystemVu meet California Title 24, ASHRAE 90.1 and IECC Fault Detection and Diagnostic (FDD) requirements.
 - i. Shall be capable of introducing up to 100% outdoor air.
 - j. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements.
 - k. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
 - l. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory installed only. Outdoor air sensor set point shall be adjustable and shall range from 40°F to 100°F (4°C to 38°C).
 - m. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
 - n. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.
 - o. Dampers shall be completely closed when the unit is in the unoccupied mode.

- p. Economizer controller shall accept a 0 to 10 vdc CO 2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
- q. Compressor lockout temperature on POL224 control is adjustable from -45°F to 80°F (-43 to 26°C), set at a factory default of 32°F (0°C).
- r. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
- s. Contains LED indication for free cooling, sensor, and damper operation.
- 3. Wi-Fi/WLAN stick for EconomizerONE POL224 (field-installed): This item allows use of the Siemens Climatix™ mobile application.
- 4. Two-Position Damper (Field-installed only):
 - a. Damper shall be a Two-Position Damper. Damper travel shall be from the full closed position to the field adjustable%-openseal-point.
 - b. Damper shall include adjustable damper travel from 25% to 100% (full open).
 - c. Damper shall include single or dual blade, gear driven dampers and actuator motor.
 - d. Actuator shall be direct coupled to damper gear. No linkage arms or control rods shall be acceptable.
 - e. Damper will admit up to 100% outdoor air for applicable rooftop units.
 - f. Damper shall close upon indoor (evaporator) fan shutoff and/or loss of power.
 - g. The damper actuator shall plug into the rooftop unit's wiring harness plug. No hard wiring shall be required.
 - h. Outside air hood shall include aluminum water entrainment filter.
- 5. Manual damper (Field-installed only):
 - a. Manual damper package shall consist of damper, air inlet screen, and rain hood which can be preset to admit up to 25 or 50% outdoor air for year round ventilation.
- 6. Humidi-MiZer® Adaptive Dehumidification System: The Humidi-MiZer Adaptive Dehumidification System shall be factory installed and shall provide greater dehumidification of the occupied space by 2 modes of dehumidification operations in addition to its normal design cooling mode:
 - a. Subcooling mode further sub cools the hot liquid refrigerant leaving the condenser coil when both temperature and humidity in the space are not satisfied.
 - b. Hot gas reheat mode shall mix a portion of the hot gas from the discharge of the compressor with the hot liquid refrigerant leaving the condenser coil to create a 2-phase heat transfer in the system, resulting in a neutral leaving air temperature when only humidity in the space is not satisfied.
 - c. Includes low ambient controller.
- 7. Low Ambient Control Package:
 - a. Controller shall control coil head pressure by condenser fan speed modulation or condenser fan cycling and windbaffles.
 - b. Shall consist of solid-state control and condenser coil temperature sensor to maintain condensing temperature between 90°F (32°C) and 110°F (43°C) at outdoor ambient temperatures down to -20°F (-29°C). For full low ambient control range, winter start kit is required.
- 8. Flue Shield:
 - a. Flue shield shall provide protection from the hot sides of the gas flue hood.
- 9. Condenser Coil Hail Guard Assembly (Factory or field installed)

- a. Shall protect against hail and additional coil damage.
 - b. Shall be louvered type
10. Unit-Mounted, Non-Fused Disconnect Switch
- a. Available on 7.5 to 12.5 ton units with factory equipped FLA of 80 amps or less, or 15 ton units with FLA of 80 amps or less (460/575V) or 100 amps or less (208/230V)
 - b. Switch shall be factory installed, internally mounted.
 - c. National Electric Code (NEC) and UL approved non-fused switch shall provide unit power shutoff.
 - d. Shall be accessible from outside the unit.
 - e. Shall provide local shutdown and lockout capability.
 - f. Sized only for the unit as ordered from the factory. Does not accommodate field-installed devices.
11. Convenience Outlet:
- a. Factory Installed Powered convenience outlet.
 - 1) Outlet shall be powered from main line power to the rooftop unit.
 - 2) Outlet shall be powered from line side or load side of disconnect by installing contractor, as required by code. If outlet is powered from load side of disconnect, unit electrical ratings shall be UL certified and rated for additional outlet amperage.
 - 3) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
 - 4) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
 - 5) Voltage required to operate convenience outlet shall be provided by a factory installed step-down transformer.
 - 6) Outlet shall be accessible from outside the unit.
 - 7) Outlet shall include a field installed "Wet in Use" cover.
 - b. Factory-Installed Non-Powered convenience outlet.
 - 1) Outlet shall be powered from a separate 115/120v power source.
 - 2) A transformer shall not be included.
 - 3) Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle.
 - 4) Outlet shall include 15 amp GFI receptacles with independent fuse protection.
 - 5) Outlet shall be accessible from outside the unit.
 - 6) Outlet shall include a field installed "Wet in Use" cover.
 - c. Field-Installed Non-Powered convenience outlet.
 - 1) Outlet shall be powered from a separate 115/120v power source.
 - 2) A transformer shall not be included.
 - 3) Outlet shall be field-installed and internally mounted with easily accessible 115-v female receptacle.
 - 4) Outlet shall include 20 amp GFI receptacles. This kit provides a flexible installation method which allows code compliance for height requirements of the GFCI outlet from the finished roof surface as well as the capability to relocate the outlet to a more convenient location.
 - 5) Outlet shall be accessible from outside the unit.

- 6) Outlet shall include a field installed “Wet in Use” cover.
12. Flue Discharge Deflector:
 - a. Flue discharge deflector shall direct unit exhaust vertically instead of horizontally.
 - b. Deflector shall be defined as a “natural draft” device by the National Fuel and Gas (NFG) code.
13. Thru-the-Base Connectors:
 - a. Kits shall provide connectors to permit gas and electrical connections to be brought to the unit through the unit basepan.
 - b. Minimum of 4 connection locations per unit.
14. Supply Duct Cover (size 16 only):
 - a. Required when field converting the factory standard vertical duct supply to horizontal duct supply configuration. One required per unit.
15. Propeller Power Exhaust:
 - a. Power exhaust shall be used in conjunction with an integrated economizer.
 - b. Independent modules for vertical or horizontal return configurations shall be available.
 - c. Horizontal power exhaust shall be mounted in return ductwork.
 - d. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0 to 100% adjustable setpoint on the economizer control.
16. Roof Curbs (Vertical):
 - a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
 - b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
 - c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
17. High Altitude Gas Conversion Kit:Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 2000 to 7000 ft (610 to 2134 m) elevation with natural gas or from 0 to 7000 ft (0 to 2134 m) elevation with liquefied propane.
18. Outdoor Air Enthalpy Sensor:
 - a. The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.
19. Return Air Enthalpy Sensor:
 - a. The return air enthalpy sensor shall be used in conjunction with an outdoor air enthalpy sensor to provide differential enthalpy control.
20. Indoor Air Quality (CO2) Sensor:
 - a. Shall be able to provide demand ventilation indoor air quality (IAQ) control.
 - b. The IAQ sensor shall be available duct mounted in the return air main. The setpoint shall have adjustment capability.
21. Smoke detectors:
 - a. Shall be a 4-Wire Controller and Detector.
 - b. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.

- c. Shall use magnet-activated test/reset sensor switches.
 - d. Shall have tool-less connection terminal access.
 - e. Shall have a recessed momentary switch for testing and resetting the detector.
 - f. Controller shall include:
 - 1) One set of normally open alarm initiation contacts for connection to an initiating device circuit on a fire alarm control panel.
 - 2) Two Form-C auxiliary alarm relays for interface with rooftop unit or other equipment.
 - 3) One Form-C supervision (trouble) relay to control the operation of the Trouble LED on a remote test/reset station.
 - 4) Capable of direct connection to 2 individual detector modules.
 - 5) Can be wired to up to 14 other duct smoke detectors for multiple fan shutdown applications.
22. Time Guard:
- a. Shall prevent compressor short-cycling by providing a 5-minute delay (± 2 minutes) before restarting a compressor after shutdown for any reason.
 - b. One device shall be required per compressor.
23. Hinged Access Panels:
- a. Shall provide easy access through integrated quarter turn latches.
 - b. Shall be on major panels of: filter, control box, fan motor, and compressor.
24. Condensate overflow switch:
- a. This sensor and related controller monitors the condensate level in the drain pan and shuts down compression operation when overflow conditions occur. It includes:
 - b. Indicator light — solid red (more than 10 seconds on water contact — compressors disabled), blinking red (sensor dis-connected).
 - c. 10 second delay to break — eliminates nuisance trips from splashing or waves in pan (sensor needs 10 seconds of constant water contact before tripping).
 - d. Disables the compressor(s) operation when condensate plug is detected, but still allows fans to run for Economizer.
25. MERV-13 – 4 in. Return Air filters (Factory Installed Only):
- a. Provide factory installed 4” filter rack
26. Phase Monitor Control:
- a. Shall monitor the sequence of 3-phase electrical system to provide a phase reversal protection.
 - b. Shall monitor the 3-phase voltage inputs to provide a phase loss protection for the 3-phase device.
 - c. Will work on either a Delta or Wye power connection.
27. Horn/Strobe Annunciator:
- a. Provides an audible/visual signaling device for use with factory-installed option or field installed accessory smoke detectors.
 - b. Requires installation of a field-supplied 24-v transformer suitable for 4.2 VA (AC) or 3.0 VA (DC) per horn/strobe accessory.
 - c. Requires field-supplied electrical box, North American 1-gang box, 2 in. (51 mm) x 4 in. (102 mm).
 - d. Shall have a clear colored lens.
28. High Short Circuit Current Rating (SCCR) Protection:

- a. Factory-installed option shall provide high short circuit current protection to compressor and all indoor and outdoor fan motors rated at 10 kA against high potential fault current situations. (Standard unit comes with 5 kA rating.)

2.4 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C1071, Type I or II.
 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location to have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
- B. Curb Dimensions: Where new curbs are required, provide curbs to match height of existing curbs.

2.5 SOURCE QUALITY CONTROL

- A. AHRI Compliance:
 1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
 2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
 3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
 4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- B. AMCA Compliance:
 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
 2. Damper leakage tested according to AMCA 500-D.
 3. Operating Limits: Classify according to AMCA 99.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems". Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.
 - 1. Install normal-weight, 3000-psi (20.7-MPa), compressive strength (28-day) concrete mix inside roof curb, 4 inches (100 mm) thick. Concrete, formwork, and reinforcement are specified with concrete.

3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to RTU, allow space for service and maintenance.
- C. Connect piping to unit with flexible connectors.
- D. Connect condensate drain pans using NPS 1-1/4 (DN 32), ASTM B88, Type M (ASTM B88M, Type C) copper tubing. Extend to nearest equipment or roof drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- E. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

3.4 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.

3.5 ELECTRICAL CONNECTIONS

- A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate is to be laminated acrylic or melamine plastic signs as layers of black with engraved white letters at least 1/2 inch (13 mm) high.
 - 2. Locate nameplate where easily visible.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.7 STARTUP SERVICE

- A. **Perform** startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Inspect for visible damage to unit casing.
 - 3. Inspect for visible damage to furnace combustion chamber.
 - 4. Inspect for visible damage to compressor, coils, and fans.
 - 5. Inspect internal insulation.

6. Verify that labels are clearly visible.
7. Verify that clearances have been provided for servicing.
8. Verify that controls are connected and operable.
9. Verify that filters are installed.
10. Clean condenser coil and inspect for construction debris.
11. Clean furnace flue and inspect for construction debris.
12. Connect and purge gas line.
13. Remove packing from vibration isolators.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency:
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.

- a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
- a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
- a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.8 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 CLEANING

- A. After completing system installation and testing, adjusting, and balancing RTUs and air-distribution systems, clean RTUs internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections
- C. Tests and Inspections:
 - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. RTU will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237416.11

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.

37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.
58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVA_r or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.

ELMORE COUNTY
ADMINISTRATION REMODEL
MOUNTAIN HOME, ID

81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.

131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
32. PVC: Rigid PVC conduit.
33. PVC-40: Schedule 40 rigid PVC conduit.
34. PVC-80: Schedule 80 rigid PVC Conduit.
35. PVC-A: Type A rigid PVC concrete-encased conduit.
36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.

37. RGS: See ERM-C-S-G.
38. RMC: See ERM-C.
39. RTRC: Reinforced thermosetting resin conduit.
40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.

36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.
63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.

4. SEOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.

- g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical

power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

12. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
13. Jacket: A continuous nonmetallic outer covering for conductors or cables.
14. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
15. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
16. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
17. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
18. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
19. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
20. Sheath: A continuous metallic covering for conductors or cables.
21. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
22. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
23. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or

filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.2 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without Owner's written permission.
 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.

1.3 ACTION SUBMITTALS

1.4 CLOSEOUT SUBMITTALS

- A. Facility EPM Program Binders:
1. Complete Set: On approved online or cloud solution.
 2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb (105 GSM), acid-free, bond paper.
- B. Operation and Maintenance Data:
1. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
 - f. List of load-current and overload-relay heaters with related motor nameplate data.
 - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.

- i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.
- C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation, including the following:
 - 1. Software operating and upgrade manuals.
 - 2. Names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Testing and adjusting of panic and emergency power features.
 - 6. For lighting controls, include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.
- D. Software:
 - 1. Program Software Backup: Provide username and password for approved online or cloud solution.
 - 2. Provide to Owner upgrades and unrestricted licenses for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.5 QUALIFICATIONS

- A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.
- B. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
- C. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:
 - 1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
 - 2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).
- D. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:

1. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
 2. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
- E. Electrical Power Monitoring Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.
- F. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

- A. Substitution requests for electrical equipment will be entertained under the following conditions:
1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
 2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
 3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

- A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.
- B. Applicable Standards:
1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
 2. General Characteristics:
 - a. Volume 1 - Introduction:

- 1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
 - 2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
 - 3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
- b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
- 1) Include training requirements for employees and contractors.
 - 2) Include list of known facility hazards impacting IT&R activities.
 - 3) Include approval and permitting procedures for IT&R activities.
 - 4) Include incident emergency response procedures.
 - 5) Include emergency shutdown procedures.
 - 6) Include electrical disaster recovery procedures.
- c. Volume 3 - Operating Procedures for Electrical Equipment and Controls:
- d. Volume 4 - Facility Diagrams and Schedules:
- 1) Include single-line diagrams.
 - 2) Include grounding and bonding diagrams.
 - 3) Include essential wiring diagrams.
 - 4) Include system automation diagrams (SCADA, BMS, lighting, HVAC, etc.).
 - 5) Include records of switchgear, switchboard, and panelboard schedules.
 - 6) Include time-current curves for overcurrent protective devices.
 - 7) Include list of load-current and overload-relay heaters with related motor nameplate data.
- e. Volume 5 - Inventory of Facility Equipment Using Electrical Power:
- 1) Include simplified floor plans showing equipment locations.
 - 2) Identify critical equipment (electrical or otherwise).
 - 3) Include identifying designations and nameplate data.
 - 4) Include warranty and maintenance contract information.
- f. Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
- 1) Include schedules of maintenance material items recommended to be stored at facility.
 - 2) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
 - 3) Include calibration and servicing data for each item.
- g. Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
- 1) Include tables showing frequency of activities for each item.
 - 2) Include annual schedule with activities mapped to specific days of the year.
 - 3) Include exterior pole inspection and repair procedures.

- h. Volume 10 - Spare Parts List:
 - 1) Include list of all parts required to perform IT&R procedures.
 - 2) Identify quantities of which parts are recommended to be stored on-site.
 - 3) Include source contact information and budget cost for each item.

- i. Volume 11 - Construction Project Closeout Record Documentation:
 - 1) Include records of power system studies and photometric studies.
 - 2) Include records of risk assessment studies.
 - 3) Include records of electrical system startup and commissioning activities.
 - 4) Include records of baseline inspections and tests.
 - 5) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
 - 6) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

- A. Facility EPM Program must be developed by qualified EPM specialist.
- B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - 1. Renovation Projects:
 - a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
- C. Compile operation and maintenance data from Facility EPM Program analysis and submit Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.3 FIELD QUALITY CONTROL

- A. Administrant for Low-Voltage Electrical Tests and Inspections:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

- B. Administrant for Field Tests and Inspections of Lighting Installations:
 - 1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

3.4 CLOSEOUT ACTIVITIES

- A. Demonstration: With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel and building occupants how to operate the following systems and equipment:
 - 1. Lighting control devices specified in Section 260923 "Lighting Control Devices."
 - 2. Lighting control systems specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
 - 3. Lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."

- B. Training: With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
 - 1. How to implement Facility EPM Program.
 - 2. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
 - 3. How to adjust, operate, and maintain hardware and software specified in Section 260936 "Modular Dimming Controls. "Laptop computer must be used in training.
 - 4. How to adjust, operate, and maintain hardware and software specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
 - 5. How to adjust, operate, and maintain luminaires and photoelectric controls specified in Section 265619 "LED Exterior Lighting."

- C. Provide video recordings of training sessions to Owner.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data:
 - 1. Copper building wire.
 - 2. Metal-clad cable, Type MC.
 - 3. Connectors and splices.
- B. Product Schedule: Indicate type, use, location, and termination locations.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
 - 1. Type THHN and Type THWN-2. Comply with UL 83.
 - 2. Type THW and Type THW-2. Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 - 3. Type XHHW-2. Comply with UL 44.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

- I. ASD Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is permitted.
 - 4. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess.

Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1 inch (25 mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.

- B. Cables will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

ELMORE COUNTY
ADMINISTRATION REMODEL
MOUNTAIN HOME, ID

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Field Quality-Control Submittals:

1. Field quality-control reports.

1.2 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
 - a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Rod electrodes.
 - 3) Ring electrodes.
 - 4) Grounding arrangements and connections for separately derived systems.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:

1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. ASTM - Bare Copper Grounding and Bonding Conductor:
 - 1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3
 - b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
 - c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
 - d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING CLAMPS

- A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

2.3 GROUNDING AND BONDING BUSHINGS

- A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - D. UL KDER - Bonding Bushing:
 - E. UL KDER - Grounding Bushing:
 - 1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.
- 2.4 GROUNDING AND BONDING HUBS
- A. Description: Hubs with certified grounding or bonding locknut.
 - B. Source Limitations: Obtain products from single manufacturer.
 - C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - D. UL KDER - Grounding and Bonding Hub:
 - 1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.
- 2.5 GROUNDING AND BONDING CONNECTORS
- A. Source Limitations: Obtain products from single manufacturer.
 - B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
 - b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.
- C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:
- 1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.
- D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
- 1. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

2.6 GROUNDING AND BONDING BUSBARS

- A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
- 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- D. UL KDER - Equipment Room Grounding and Bonding Busbar:
- 1. General Characteristics:
 - a. Bus: Rectangular bar of annealed copper.
 - b. Mounting Stand-Off Insulators: Lexan or PVC.
 - 1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
 - 2. Options:
 - a. Dimensions: 1/4 by 4 inch in cross section; length as indicated on Drawings.
 - b. Predrilled Hole Pattern: Suitable for installing specified grounding and bonding connectors.
 - c. Mounting Hardware: Stand-off brackets that provide 2 inch clearance to access rear of bus. Brackets and bolts must be stainless steel.

- E. UL KDER - Rack and Cabinet Bonding Busbar:
 - 1. General Characteristics:
 - a. Bus: Rectangular bar of hard-drawn solid copper.
 - b. Horizontal Mounting Dimensions: Designed for mounting in 23 inch wide equipment racks or cabinets.
 - c. Vertical Mounting Dimensions: Designed for mounting in 72 inch high equipment racks or cabinets.
 - d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
 - e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.7 GROUNDING (EARTHING) ELECTRODES

- A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.
- B. Source Limitations: Obtain products from single manufacturer.
- C. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria:
 - a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inch (50 mm) minimum from wall, 6 inch (150 mm) above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

- A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
- B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
- C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.
- D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
- F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.

3.4 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.5 SELECTION OF SIGNAL REFERENCE GRIDS

- A. Access Floor Signal Reference Grid:
 - 1. Install 6 AWG bonding conductors in a grid pattern under floor.

- a. Install grid bonding conductors on 4 ft (1200 mm) centers, so as to permit bonding of one structural pedestal for each access floor tile. Connect grid conductors together where they cross each other.

3.6 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:

1. Conductors:

- a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

- a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
- b. Make connections with clean, bare metal at points of contact.
- c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
- d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
- e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

- 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
- 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

- g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
 - i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft (18 m) apart.
3. Equipment Grounding:
- a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
 - e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

- f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:
 - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω .
 - b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 Ω .
 - c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 Ω .
 - d. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 Ω .

3.8 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.

1.2 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 3. Channel Width: 1-1/4 inch (31.75 mm).
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Channel Material: 6063-T5 aluminum alloy.
 - 3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 4. Channel Width: 1-1/4 inch (31.75 mm).
 - 5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, [**zinc-coated**] [**stainless**] steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).
 - 6. Toggle Bolts: All steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101
- B. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- C. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."

- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38 mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.
 - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Type EMT-A and Type EMT-SS duct raceways and elbows.
 - 2. Type ERMC-A and Type ERMC-SS duct raceways, elbows, couplings, and nipples.
 - 3. Type IMC duct raceways.
 - 4. Type PVC duct raceways and fittings.
 - 5. Type RTRC-AG duct raceways and fittings.
 - 6. Type RTRC-BG duct raceways and fittings.
 - 7. Fittings for conduit, tubing, and cable.
 - 8. Electrically conductive corrosion-resistant compounds for threaded conduit.
 - 9. Solvent cements.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions:
 - 1. Type EMT-A and Type EMT-SS duct raceways and elbows.
 - 2. Type ERMC-A and Type ERMC-SS duct raceways, elbows, couplings, and nipples.
 - 3. Type IMC duct raceways.
 - 4. Type PVC duct raceways and fittings.
 - 5. Type RTRC-AG duct raceways and fittings.
 - 6. Type RTRC-BG duct raceways and fittings.
 - 7. Fittings for conduit, tubing, and cable.
 - 8. Electrically conductive corrosion-resistant compounds for threaded conduit.
 - 9. Solvent cements.

PART 2 - PRODUCTS

2.1 TYPE EMT-A AND TYPE EMT-SS DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL FJMX - Aluminum Electrical Metal Tubing (EMT-A) and Elbows:

1. Material: Aluminum.
2. Options:
 - a. Minimum Trade Size: Metric designator 16 (trade size 1/2).

D. UL FJMX - Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:

1. Material: Stainless steel.
2. Options:
 - a. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.2 TYPE ERMCA AND TYPE ERMCA-SS DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.3 TYPE IMC DUCT RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYBY; including UL 1242.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DYBY - Steel Intermediate Metal Conduit (IMC):

1. Options:
 - a. Exterior Coating: Zinc.
 - b. Interior Coating: Zinc with organic top coating.
 - c. Minimum Trade Size: Metric designator 16 (trade size 1/2).

2.4 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

1. Dimensional Specifications: Schedule 40.
2. Options:
 - a. Minimum Trade Size: Metric designator 16 (trade size 1/2).
 - b. Markings: For use with maximum 90 deg C wire.

2.5 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL EBMB - Duct Fittings for Hazardous (Classified) Locations:

1. Listing Criteria: UL CCN EBMB; including UL 1203.

D. UL DWTT - Fittings for Type ERMC, Type IMC, and Type PVC Duct Raceways:

1. Listing Criteria: UL CCN DWTT; including UL 514B.

2. Options:
 - a. Material: Steel.
 - b. Coupling Method: Compression coupling.
 - c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

2.6 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

2.7 SOLVENT CEMENTS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Outdoors:
 1. Exposed and Subject to Severe Physical Damage: ERMC.
 2. Exposed and Subject to Physical Damage: ERMC.

- a. Locations less than 2.5 m (8 ft) above finished floor.
 3. Exposed and Not Subject to Physical Damage: IMC.
 4. Concealed Aboveground: EMT.
 5. Direct Buried: PVC-40.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
- C. Indoors:
1. Hazardous Classified Locations: ERMC.
 2. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:
 - a. Loading docks.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 3. Exposed and Subject to Physical Damage: ERMC. Locations include the following:
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 - b. Stub-ups to above suspended ceilings.
 4. Exposed and Not Subject to Physical Damage: EMT.
 5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 6. Damp or Wet Locations: ERMC.
- D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-A: Article 358 of NFPA 70 and NECA NEIS 102.
 2. Type EMT-SS: Article 358 of NFPA 70 and NECA NEIS 101.
 3. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 4. Type ENT: Article 362 of NFPA 70 and NECA NEIS 102.
 5. Type HDPE and Type EPEC: Article 353 of NFPA 70 and NECA NEIS 111.
 6. Type ERMC-A: Article 344 of NFPA 70 and NECA NEIS 102.
 7. Type ERMC-SS: Article 344 of NFPA 70 and NECA NEIS 101.
 8. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
 9. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
 10. Type FMC-A: Article 348 of NFPA 70 and NECA NEIS 102.

11. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
12. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
13. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
14. Type LFNC: Article 342 of NFPA 70 and NECA NEIS 111.
15. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
16. Type RTRC: Article 355 of NFPA 70 and NECA NEIS 111.
17. Expansion Fittings: NEMA FB 2.40.
18. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

- a. Complete duct raceway installation before starting conductor installation.
- b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
- c. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch (300 mm) of changes in direction.
- d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
- g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
 - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2) Where an underground service duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway and equipment.
 - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6) Where otherwise required by NFPA 70.
- i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
- j. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.

- k. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.
 - o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts.
2. Types EMT-A, ERMC-A, and FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
3. Types ERMC and IMC:
- a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
4. Type ERMC-S-PVC:
- a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC duct raceway.
 - c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
5. Types FMC, LFMC, and LFNC:
- a. Provide a maximum of 36 inch of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
6. Types PVC, HDPE, and EPEC:

- a. Do not install Type PVC, Type HDPE, or Type EPEC conduit where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent welding and fittings.
7. Type RTRC: Do not install Type RTRC conduit where ambient temperature exceeds 230 deg F (110 deg C).
8. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT, IMC, or ERM C for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
9. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
10. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. ERM C-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - b. EMT: Provide compression fittings. Comply with NEMA FB 2.10.
 - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
11. Expansion-Joint Fittings:
 - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F (17 deg C) and that have straight-run length that exceeds 25 ft (7.6 m). Install in runs of aboveground ERM C and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
 - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - 1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - 2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - 3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 - 4) Attics: 135 deg F (75 deg C) temperature change.

- c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
12. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.
 13. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
 - a. Provide warning signs.

D. Interfaces with Other Work:

1. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
2. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT - Metallic Outlet Boxes and Covers:

1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: Minimum 2 inch (50 mm).
 - c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb (23 kg).

D. UL QCIT - Metallic Conduit Bodies:

1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCIT - Metallic Device Boxes:

1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:
 - a. Material: Sheet steel.
 - b. Sheet Metal Depth: minimum 2 inch (50 mm).

F. UL QCIT - Metallic Extension Rings:

1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:

1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

H. UL QCIT - Metallic Raised-Floor Boxes and Floor Box Covers:

1. Description: Box mounted in raised-floor with floor box cover and other components to complete floor box enclosure.

I. UL QCIT - Metallic Recessed Access-Floor Boxes and Recessed Floor Box Covers:

1. Description: Floor box with provisions for mounting wiring devices below floor surface and floor box cover with provisions for passage of cords to recessed wiring devices mounted within floor box.

J. UL QCIT - Metallic Concrete Boxes and Covers:

1. Description: Box intended for use in poured concrete.

2.2 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL BGUIZ - Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

D. UL BGUIZ - Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2.3 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:

1. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.

D. UL QCIT or QCMZ - Illuminating Cover Plates for Device Boxes:

1. Options:
 - a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
 - b. Wallplate Material: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
 - c. Color: As indicated on architectural Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 - 1. Outdoors:
 - a. Type 3R unless otherwise indicated.
 - b. Locations Exposed to Hosedown: Type 4.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
 - 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: Type 12.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
 - f. Locations Exposed to Hosedown: Type 4.
 - g. Locations Exposed to Brief Submersion: Type 6.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: Type 4X.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.

3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for wallplates and covers.
14. Identification: Provide labels for boxes and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 - c. Label each box with engraved metal or laminated-plastic nameplate.

3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Steel Wall Sleeves:
 - 1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Cast-Iron Wall Sleeves:
 - 1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
- C. PVC Pipe Sleeves:
 - 1. General Characteristics: ASTM D1785, Schedule 40.
- D. PVC Molded Sleeves:
 - 1. General Characteristics: With nailing flange for attaching to wooden forms.
- E. PE or PP Molded Sleeves:
 - 1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Round, Galvanized-Steel, Sheet Metal Sleeves:
 - 1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch (0.6 mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 SLEEVE-SEAL SYSTEMS

- A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- B. Options:

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

- A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

- A. Performance Criteria:
 1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.

- b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4 inch (6.4 mm) annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations:
1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
 2. Install steel pipe sleeves. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data:
 - 1. Labels.
 - 2. Tags.
 - 3. Signs.
 - 4. Cable ties.
 - 5. Miscellaneous identification products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
 - 1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft (2.3 m) above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
 - 1. Safety Colors: NEMA Z535.1.
 - 2. Facility Safety Signs: NEMA Z535.2.
 - 3. Safety Symbols: NEMA Z535.3.
 - 4. Product Safety Signs and Labels: NEMA Z535.4.
 - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with NFPA 70E requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- F. 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.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
 - 1. Black letters on orange field.
 - 2. Legend: Indicate voltage and system or service type.

- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Color for Neutral: White.
 - 4. Color for Equipment Grounds: Green.
 - 5. Colors for Isolated Grounds: Green with two or more yellow stripes.

- C. Warning Label Colors:
 - 1. Identify system voltage with black letters on orange background.

- D. Warning labels and signs must include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

- E. Equipment Identification Labels:
 - 1. Black letters on white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

- C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil (0.08 mm) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.

2. Marker for Labels:
 - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.4 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

B. Write-on Tags:

1. Polyester Tags: 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags:
 - a. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 SIGNS

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4 inch (6.4 mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inch (180 by 250 mm).

2.6 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
 - 1. .
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- H. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- I. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "EMERGENCY POWER."

2. "POWER."
3. "UPS."

J. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

K. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

L. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

M. Self-Adhesive Labels:

1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high label; where two lines of text are required, use labels 2 inch (50 mm) high.

N. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

P. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

Q. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.

T. Metal Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

U. Nonmetallic Preprinted Tags:

1. Place in location with high visibility and accessibility.

2. Secure using general-purpose cable ties.

V. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using general-purpose cable ties.

W. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on minimum 1-1/2 inch (38 mm) high sign; where two lines of text are required, use signs minimum 2 inch (50 mm) high.

X. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

Y. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch (13 mm) high letters on 1-1/2 inch (38 mm) high sign; where two lines of text are required, use labels 2 inch (50 mm) high.

Z. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
 1. "EMERGENCY POWER."

2. "POWER."
 3. "UPS."
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.
- F. Auxiliary Electrical Systems Conductor Identification: Marker tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- G. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- H. Concealed Raceways and Duct Banks, More Than 1000 V, within Buildings: Apply floor marking tape to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within 12 inch (300 mm) of floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in building, or concealed above suspended ceilings.
- I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- L. Operating Instruction Signs: Self-adhesive labels.
- M. Equipment Identification Labels:
1. Indoor Equipment: Self-adhesive label.

2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
 - g. Substations.
 - h. Emergency system boxes and enclosures.
 - i. Motor-control centers.
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power-transfer equipment.
 - p. Contactors.
 - q. Remote-controlled switches, dimmer modules, and control devices.
 - r. Battery-inverter units.
 - s. Battery racks.
 - t. Power-generating units.
 - u. Monitoring and control equipment.
 - v. UPS equipment.

END OF SECTION 260553

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for commissioning electrical systems, subsystems and equipment. This Section supplements the general requirements specified in Section 019113, "Commissioning Requirements".
- B. Refer to Section 019113, "Commissioning Requirements", for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.2 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 26.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 019113, "Commissioning Requirements". The commissioning process, which the Contractor is responsible to execute, is defined in Section 019113, "Commissioning Requirements". A Commissioning Agent (CxA) appointed by the University will manage the commissioning process.

1.3 DEFINITIONS

- A. Refer to Section 019113, "Commissioning Requirements", for definitions.

1.4 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in Division 26 is part of the construction process. Documentation and testing of these systems, as well as training of the University's Operation and Maintenance personnel in accordance with the requirements of Section 019113 and of Division 26, is required in cooperation with University and the Commissioning Agent.
- B. The Electrical systems commissioning will include the systems listed in Section 019113, "Commissioning Requirements".

1.5 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Contractor will submit a list of submittals. The Commissioning Authority will review the list and identify submittals that require review. Contractor will deliver submittals identified by Commissioning Authority.

- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 019113, "Commissioning Requirements".

1.6 RELATED WORK

- A. Section 220800 – Commissioning of Plumbing Systems
- B. Section 230800 – Commissioning of Mechanical Systems

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. Manufacturer shall include required proprietary test equipment. Manufacturer shall furnish the test equipment, demonstrate its use, and assist the Commissioning Team in the commissioning process.
- B. Refer to 019113 for the minimum testing equipment required to be delivered by the Contractor for the execution of Functional Testing.
- C. Refer to 019113 for the calibration requirements of test equipment.

PART 3 - EXECUTION

3.1 SITE OBSERVATIONS

- A. Commissioning of the Building Electrical Systems will require inspection of individual elements of the Electrical construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 019113 and the Commissioning Plan to schedule inspections as required to support the commissioning process.

3.2 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Functional Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists through online Commissioning tool. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information submitted in the checklist is not accurate, the Commissioning Agent will mark the checklist "In Progress" and the Contractor will make the corrections and resubmit. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the

broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be marked "In Progress" and the Contractor will make the corrections and resubmit. Refer to Section 019113, "Commissioning Requirements", for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTOR'S TESTS

- A. Contractor tests as required by other sections of Division 26 shall be scheduled and documented in accordance with Division 01, "General Requirements". All testing shall be incorporated into the project schedule. Contractor shall give no less than 7 days' notice of testing. The Commissioning Authority will witness selected Contractor tests at the sole discretion of the Commissioning Authority. Contractor tests shall be completed prior to scheduling Functional Testing.

3.4 FUNCTIONAL TESTING

- A. The Commissioning Process includes Functional Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Authority will prepare detailed Functional Test procedures. The Contractor shall review and comment on the tests prior to approval. The Contractor shall include the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Authority will witness and document the testing. See Section 019113, "Commissioning Requirements", for additional details.

3.5 TRAINING

- A. Training of the University's operation and maintenance personnel is required in cooperation with the University and Commissioning Authority. Include competent, factory authorized personnel to deliver instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas in accordance with the requirements of Section 019113. The instruction shall be scheduled in coordination with the University after submission and approval of formal training plans. Refer to Section 019113, "Commissioning Requirements", and Division 26 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

- A. Product Data:
 - 1. Outdoor photoelectric switches, solid state, flexible mounting.
 - 2. Indoor occupancy and vacancy sensors.
 - 3. Switchbox-mounted occupancy sensors.
 - 4. Digital timer light switch.
 - 5. Outdoor motion sensors.
 - 6. Lighting contactors.
 - 7. Emergency shunt relay.
 - 8. Conductors and cables.

- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

- C. Field quality-control reports.

1.2 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranties.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

- A. Description: Solid state, with SPST dry contacts rated for 1000 W LED, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
 - 1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Wall or Ceiling-mounted, solid-state indoor occupancy sensors.
2. Dual technology.
3. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
4. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
5. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
6. Mounting:
 - a. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
 - b. Relay: Externally mounted through a 1/2 inch (13 mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
8. Bypass Switch: Override the "on" function in case of sensor failure.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); turn lights off when selected lighting level is present.

B. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6 inch (150 mm) minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch (23 200 sq. mm), and detect a person of average size and weight moving not less than

12 inch (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inch/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96 inch (2440 mm) high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 sq. ft. (220 sq. m) when mounted 48 inch (1200 mm) above finished floor.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V, and 800 W incandescent.

B. Wall-Switch Sensor:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage, 120 and 208 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lx). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
9. Color: White.
10. Faceplate: Color matched to switch.

2.4 LIGHTING CONTACTORS

A. Description: Electrically operated and electrically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.

2.5 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 1. Coil Rating: 120 V.

2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- C. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

END OF SECTION 260923

SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.2 ACTION SUBMITTALS

- A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and cover plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Sound data including results of operational tests of central dimming controls.
4. Operational documentation for software and firmware.

- B. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

- C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation in accordance with NECA 407.

1.5 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of standalone multipreset modular dimming controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.
 1. Initial Extended Warranty Period: Two year(s) from date of Substantial Completion, for labor, materials, and equipment.
 2. Follow-on Extended Warranty Period: Eight year(s) from date of Substantial Completion, for materials that failed because of transient voltage surges only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.
- B. Surge Protective Device: Factory installed as an integral part of control components or field-mounted surge suppressors complying with UL 1449, SPD Type 2.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- D. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- E. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

- A. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.
- B. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
 2. A vertical barrier separating branch circuits from control wiring.
- C. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
1. Timing Unit:
 - a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
 - b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
 - c. Four independent schedules, each having 24 time periods.
 - d. Schedule periods settable to the minute.
 - e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
 - f. 10 special date periods.
 2. Sequencing Control with Override:
 - a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
 - b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
 - c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
 - d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.
 3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.
- D. Relays:
1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 120 V for tungsten, 30 A at 277 V for ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating must be not less than 14 kA. Control must be three-wire, 24 V(ac).
- E. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.
- F. Operator Interface:
1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
 2. Log and display relay on-time.
 3. Connect relays to one or more time and sequencing schemes.

2.3 MANUAL SWITCHES AND COVER PLATES

- A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
 - 1. Match color and style specified in Section 262726 "Wiring Devices."
 - 2. Integral green LED pilot light to indicate when circuit is on.
 - 3. Internal white LED locator light to illuminate when circuit is off.
- B. Cover Plates: Single and multigang cover plates as specified in Section 262726 "Wiring Devices."
- C. Legend: Engraved or permanently silk-screened on cover plate where indicated. Use designations indicated on Drawings.

2.4 FIELD-MOUNTED SIGNAL SOURCES

- A. Daylight Harvesting Switching Controls: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.
- B. Indoor Occupancy Sensors and Extreme-Temperature Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- D. Twisted-Pair Data Cable: Category 5e.
 - 1. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels in accordance with NECA 407.

- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

- A. Wiring Methods:
 - 1. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
 - 2. Conceal raceway and cables except in unfinished spaces.
 - 3. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
 - 4. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - 5. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELS

- A. Install panels and accessories in accordance with NECA 407.
- B. Mount top of trim 90 inch (2286 mm) above finished floor unless otherwise indicated.
- C. Mount panel cabinet plumb and rigid without distortion of box.
- D. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers described below. Certify compliance with manufacturer's test parameters.

a. Circuit-Breaker Tests:

- 1) Compare nameplate with Drawings and Specifications.
- 2) Inspect physical and mechanical conditions.
- 3) Inspect anchorage and alignment.
- 4) Verify that the units are clean.
- 5) Operate the circuit breaker to ensure smooth operation.
- 6) Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - a) A low-resistance ohmmeter.
 - b) Verify tightness of bolted electrical connections by calibrated torque wrench.
 - c) Thermographic survey.
- 7) Inspect operating mechanism, contacts, and arc chutes in unsealed units.
- 8) Perform insulation resistance tests for one minute on each pole, phase-to-phase, and phase-to-ground with the circuit breaker closed and across each pole using manufacturer's published data.
- 9) Perform a contact/pole-resistance test.
- 10) Perform insulation-resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be for one minute. Follow manufacturer's instructions for solid-state units.
- 11) Determine long-time pickup and delay by primary current injection.
- 12) Determine short-time pickup and delay by primary current injection.
- 13) Determine ground-fault pickup and time delay by primary current injection.
- 14) Determine instantaneous pickup by primary current injection.
- 15) Test functions of the trip unit by means of secondary injection.
- 16) Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
- 17) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset trip logs and indicators.
- 18) Verify operation of charging mechanism.

B. Nonconforming Work:

1. Lighting control panel will be considered defective if it does not pass tests and inspections.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- D. Manufacturer Services:
1. Engage factory-authorized service representative to support field tests and inspections.

3.6 SYSTEM STARTUP

- A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks in accordance with manufacturer's instructions.
 2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 MAINTENANCE

- A. Software and Firmware Service Agreement:
1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
 - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
 3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260943.23

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.
- B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Toggle switches.
 - 2. Dimmer switches.
 - 3. Single straight-blade receptacles
 - 4. Duplex straight-blade receptacles.
 - 5. Receptacles with GFCI device.
- B. Shop Drawings:
 - 1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.
- C. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation instructions issued to Installer by manufacturer for the following:
 - 1. Dimmers.
 - 2. Single straight-blade receptacles.
 - 3. Duplex straight-blade receptacles.
 - 4. Receptacles with GFCI device.
- B. Sample warranties.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Special Tools:

1. Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.
2. Proprietary equipment required to maintain, repair, adjust, or implement future changes to cord connectors.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

A. Toggle Switch:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN WMUZ and UL 20.

3. Options:

- a. Device Color: As indicated on architectural Drawings.
- b. Configuration:
 - 1) Extra-heavy-duty, 120-277 V, 15 A, single pole, double pole, three way, or four way.

4. Accessories:

- a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. Type I Dimmer Switch:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN EOYX and UL 1472 Type I dimmer.

3. Options:

- a. Device Color: As indicated on architectural Drawings.
- b. Switch Style: Toggle.
- c. Dimming Control Style: Slide.

4. Accessories:

- a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE SINGLE STRAIGHT-BLADE RECEPTACLES

A. Single Straight-Blade Receptacle:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:

- a. Reference Standards: UL CCN RTRT and UL 498.

3. Options:

- a. Device Color: As indicated on architectural Drawings.
- b. Configuration:
 - 1) Heavy-duty, NEMA 5-20R.

4. Accessories:

- a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
- b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:

1. Regulatory Requirements:

- a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
 3. Options:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration:
 - 1) Heavy-duty, NEMA 5-20R.
 4. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- B. Tamper-Resistant Duplex Straight-Blade Receptacle with USB Outlet to Power Class 2 Equipment:
1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. General Characteristics:
 - a. Reference Standards: UL CCN RTRT and UL 498.
 3. Options:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration:
 - 1) General-duty, NEMA 5-20R; one USB-A port; one USB-C port.
 - 2) General-duty, smooth face, two USB-A ports.
 - 3) General-duty, smooth face, four USB-A ports.
 4. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.
- C. General-Grade, Weather-Resistant, Tamper-Resistant Duplex Straight-Blade Receptacle with GFCI Device:
1. Regulatory Requirements:
 - a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. General Characteristics:
 - a. Reference Standards: UL CCN KCXS, UL 498, and UL 943.
3. Options:
 - a. Device Color: As indicated on architectural Drawings.
 - b. Configuration: Heavy-duty, NEMA 5-20R.
4. Accessories:
 - a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
 - b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

B. Cord Reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GFCI RECEPTACLES

- A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.3 INSTALLATION OF SWITCHES

- A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.

2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.7 SYSTEM STARTUP FOR SWITCHES

A. Perform startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

3.8 ADJUSTING

- #### A. Occupancy Adjustments for Controlled Receptacles: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.9 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

ELMORE COUNTY
ADMINISTRATION REMODEL
MOUNTAIN HOME, ID

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. Include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
 - 4. Coordination charts and tables and related data.

1.4 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting , time delay.
 - 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting , time delay.
 - 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 - 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class J, fast acting.
 - 2. Motor Branch Circuits: Class RK1, time delay.
 - 3. Large Motor Branch (601-4000 A): Class L, time delay.
 - 4. Power Electronics Circuits: Class J, high speed.
 - 5. Other Branch Circuits: Class RK1, time delay.
 - 6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 265119 - LED INTERIOR LIGHTING

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 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
 - B. Qualification Data: For testing laboratory providing photometric data for luminaires.
 - C. Product Certificates: For each type of luminaire.
 - D. Sample warranty.
- 1.5 CLOSEOUT SUBMITTALS
 - A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
- 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
- 1.7 QUALITY ASSURANCE
 - A. Luminaire Photometric Data Testing Laboratory Qualifications:
 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 - B. Provide luminaires from a single manufacturer for each luminaire type.
- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
- 1.9 WARRANTY
 - A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for sheet steel.
- C. Stainless Steel:
 - 1. Manufacturer's standard grade.
 - 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:

- a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.
2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.
- B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source ($1 \text{ lm} = 1 \text{ cd-sr}$).

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - a. Include data on features, accessories, and finishes.
 - b. Include physical description of unit and dimensions.
 - c. Battery and charger for light units.
 - d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of luminaire.
- B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.
- C. Sample Warranty: For manufacturer's warranty.

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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

- A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.
 - 1. Extended Warranty Period: Two year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with NFPA 101.
- C. Comply with NEMA LE 4 for recessed luminaires.
- D. Comply with UL 1598 for fluorescent luminaires.
- E. Lamp Base: Comply with ANSI C81.61.
- F. Bulb Shape: Complying with ANSI C79.1.

- G. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 2. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
 3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 6. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- H. External Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly must be located no less than half of distance recommended by emergency power unit manufacturer, whichever is less.
 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit

triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EXIT SIGNS

- A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Sign:
 1. Options:
 - a. Operating at nominal voltage of 208 V(ac).
 - b. Lamps for AC Operation:
 - 1) LEDs; 50,000 hours minimum rated lamp life.
 - c. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.
 - d. Master/Remote Sign Configurations:
 - 1) Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
 - 2) Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.3 MATERIALS

- A. Metal Parts:
 1. Free of burrs and sharp corners and edges.
 2. Sheet metal components must be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 1. Smooth operating, free of light leakage under operating conditions.
 2. Designed to permit relamping without use of tools.
 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Housings:
 1. Extruded aluminum housing and heat sink.
 2. Clear powder coat finish.

- D. Conduit: EMT, minimum metric designator 21 (trade size 1/2).

2.4 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 0.106 inch (2.69 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- B. Install lamps in each luminaire.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inch (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Luminaires:

1. Secure to outlet box, if provided.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Nonconforming Work:

1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.5 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
 - 1. Inspect luminaires. Replace lamps, exit signs, and luminaires that are defective.
 - a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 2. Conduct short-duration tests on all emergency lighting.

3.6 PROTECTION

- A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

SECTION 265619 - LED EXTERIOR LIGHTING

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 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaire.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - 5. Wiring diagrams for power, control, and signal wiring.
 - 6. Photoelectric relays.
 - 7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.

- B. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
- C. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source quality-control reports.
- E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. UL Compliance: Comply with UL 1598 and listed for wet location.
- D. Lamp base complying with ANSI C81.61.
- E. Bulb shape complying with ANSI C79.1.
- F. CRI of 80. CCT of 3000 K.
- G. L70 lamp life of 50,000 hours.

- H. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- I. Internal driver.
- J. Nominal Operating Voltage: 208 V ac.
- K. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- L. Source Limitations:
 - 1. Obtain luminaires from single source from a single manufacturer.

2.2 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
 - 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 - 2. Adjustable window slide for adjusting on-off set points.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, canopy ceilings, and overhang ceilings for suitable conditions where luminaires will be installed.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Install lamps in each luminaire.
- C. Fasten luminaire to structural support.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12> months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

SECTION 270010 - SUPPLEMENTAL REQUIREMENTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 REFERENCES

A. Abbreviations and Acronyms for Communications:

1. LAN: Local area network.
2. PoE: Power over Ethernet.
3. POTS: Plain old telephone service. See "public switched telephone network."
4. TCP/IP: Transmission control protocol/Internet protocol.
5. WAN: Wide area network.

B. Definitions for Communications:

1. Calling Party Control (CPC): A momentary break in phone line loop current, which is used to signal voicemail and other automated telephone company services that distant party has hung up.
2. Private Branch Exchange (PBX): Analog telephone switch that routes calls internal to a business or organization so a direct external line for each phone is unnecessary.
3. Public Switched Telephone Network (PSTN): Analog telephone technology that uses twisted-pair cables from a telephone-provider central office for the transmission medium. PSTN refers to the telephone network; POTS refers to the individual subscriber line.
4. Remote Office Phone System (ROPS): VoIP system that allows phones for a business or organization located anywhere in the world with internet connectivity to behave similar to phones connected to a PBX.
5. Ringer Equivalence Number (REN): The loading effect of a single traditional telephone ringing circuit. TIA-968 defines REN 1 as an impedance of 7000 Ω at 20 Hz (Type A ringer) or 8000 Ω from 15 Hz to 68 Hz (Type B ringer). The sum of the RENs for all devices on a subscriber line circuit may not exceed the maximum permitted REN for the subscriber line.
6. Voice over Internet Protocol (VoIP): Digital telephone packet technology that uses the internet for its transmission medium.

1.2 ACTION SUBMITTALS

- A. Coordination Drawings: Submit multidiscipline coordination drawings depicting communications equipment, devices, cabling, conduit, and duct banks in accordance with requirements specified in Section 260010 "Supplemental Requirements for Electrical."

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
2. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Manufacturer's instructions for setting field-adjustable components.
 - f. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.

1.4 QUALIFICATIONS

- A. Communications Design Professional: Design professional possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:
 1. Expertise in design of communications infrastructure and distribution equipment.
 2. BICSI Registered Communications Distribution Designer (RCDD) certification.
- B. Communications Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" and the following:
 1. Training and manufacturer certification to install, splice, and terminate communications cabling.
 2. Installation Supervisor: BICSI Technician (TECH) certification.
 3. Copper Installers: 30 percent of employees possess BICSI Copper Installer 2 (INSTC) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.
 4. Fiber Installers: 30 percent of employees possess BICSI Optical Fiber Installer 2 (INSTF) certification. Remaining employees possess BICSI Installer 1 (INST1) certification.
- C. Communications Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 1. On-site communications testing supervisor must have BICSI Technician (TECH) certification and documented training, and be experienced with testing communications equipment in accordance with BICSI testing standards.
- D. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR COMMUNICATIONS EQUIPMENT

- A. Substitution requests for communications equipment will be entertained under the following conditions:
 - 1. Substitution requests may be submitted for consideration prior to the Communications Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
 - 2. Contractor is responsible for sequencing and scheduling equipment procurement. After the Communications Preconstruction Conference, insufficient lead time for equipment delivery will not be considered a valid reason for substitution.

PART 3 - EXECUTION

3.1 INSTALLATION OF COMMUNICATIONS WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' instructions, comply with NFPA 70, NECA NEIS 1, and BICSI N1 for installation of Work specified in Division 27. Consult Architect for resolution of conflicting requirements.

3.2 FIELD QUALITY CONTROL

- A. Administrant for Communications Tests and Inspections:
 - 1. Engage qualified communications testing and inspecting agency to administer and perform tests and inspections.

END OF SECTION 270010

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. BBC: Backbone bonding conductor, for connecting multiple TBBs serving the same floor.
- B. PBB: Primary bonding busbar, located in main distribution frame room, ideally near electrical service entrance.
- C. RBB: Rack bonding busbar, located in equipment cabinets and racks.
- D. SBB: Secondary bonding busbar, located in intermediate distribution frame rooms.
- E. TBB: Telecommunications bonding backbone, for connecting SBBs to PBB.
- F. TBC: Telecommunications bonding conductor, for connecting PBB to intersystem bonding termination device or busbar at electrical service entrance.
- G. TEBC: Telecommunications equipment bonding conductor, for connecting RBBs to SBBs or PBB.
- H. UBC: Unit bonding conductor, for connecting individual communications equipment to RBBs or SBBs.

1.2 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. For communications equipment room signal reference grid.
 - 2. Include plans, elevations, sections, details, and attachments to other work.
- B. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
 - 1. Installing wire connector on conductor.
 - 2. Recommended torque values.

1.4 CLOSEOUT SUBMITTALS

- A. Record Documentation: Project record documents in accordance with Section 017839 "Project Record Documents" must include locations of PBB and SBBs, and routing of TBC, TBBs, and BBCs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.
- B. Inspect test results of grounding system measured at point of TBC connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of TBC only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF COMMUNICATIONS BUSBARS

- A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. PBB:
 - 1. Dimensions: 1/4 inch thick by 4 inch high (6.3 mm thick by 100 mm high).
 - 2. Stand-Off Distance: 2 inch (50 mm).
- C. SBB:
 - 1. Dimensions: 1/4 inch thick by 4 inch high (6.3 mm thick by 100 mm high).
 - 2. Stand-Off Distance: 2 inch (50 mm).

3.3 SELECTION OF COMMUNICATIONS BONDING CONDUCTORS

- A. Unless otherwise indicated in this Section or on Drawings, provide products specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Communications Busbar Connections:

1. TBC: Not smaller than 1/0 AWG and no smaller than largest TBB.
 2. TBB: Not smaller than 2 kemil per linear ft of conductor length, but not larger than 750 kemil, unless otherwise indicated on Drawings.
 3. BBC: Not smaller than largest TBB to which it is connected unless otherwise indicated on Drawings.
 4. TEBC: Not smaller than 2 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
 5. UBC: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted connectors.
 6. Bonding Conductors to Structural Steel: Not smaller than 6 AWG unless otherwise indicated on Drawings. Provide bolted clamp connectors.
- C. Underground Connections: Not smaller than 2 AWG. Provide welded connectors, except bolted connectors may be used in handholes or manholes and as otherwise indicated on Drawings.

3.4 INSTALLATION OF BONDING FOR COMMUNICATIONS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
1. Bonding of Communications: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with BICSI N3.
 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
1. Busbars:
 - a. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 12 inch (300 mm) above finished floor unless otherwise indicated.
 - b. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
 2. Conductors:
 - a. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
 - b. Assemble wire connector to conductor, complying with manufacturer's published instructions and as follows:
 - 1) Use crimping tool and die specific to connector.
 - 2) Pretwist conductor.
 - 3) Apply antioxidant compound to bolted and compression connections.

- c. Install in straightest and shortest route between origination and termination point, and no longer than required. Bend radius must not be smaller than 10 times diameter of conductor. No single bend may exceed 90 degrees.
 - d. Install without splices.
 - e. Support conductors at not more than 36 inch (900 mm) intervals.
 - f. Outside telecommunications rooms, install conductors in metric designator 21 (trade size 3/4) PVC-80 conduit until conduit enters telecommunications room. Install bonding conductors in EMT-A or EMT-SS when routed through plenum. Do not install bonding conductors in EMT-S unless otherwise indicated on Drawings.
 - 1) If bonding conductor must be installed in EMT-S or other ferrous metallic raceway, bond conductor to raceway using grounding bushing that complies with Section 270528 "Pathways for Communications Systems," and bond both ends of raceway to SBB.
3. Provide TBC and terminate ends to PBB and intersystem bonding busbar at electrical service entrance in accordance with Section 250.94, "Bonding for Communication Systems," of NFPA 70.
 4. Busbar Interconnections: Bond SBBs to PBB with TBBs. If more than one TBB is installed, bond TBBs together BBCs where required by TIA-607.
 5. Structural Steel: Where structural steel of steel frame building is readily accessible within room or space, bond each SBB and PBB to vertical steel of building frame.
 6. Communications Enclosures: Bond metallic enclosures of telecommunications equipment with UBCs to nearest SBB or PBB.
 7. Equipment Racks: Bond metallic components of enclosures to RBB using UBCs. Provide top-mounted RBB if not provided by enclosure or rack manufacturer. Bond RBB to SBB with TEBC. Power connection must comply with NFPA 70; equipment grounding conductor in power cord of cord- and plug-connected equipment must be considered supplemental to bonding requirements in this Section.
 8. Shielded Cable: Bond shield of shielded cable to SBB in communications rooms and spaces. Comply with TIA-568.1 and TIA-568.2 when grounding shielded balanced twisted-pair cables.
 9. Primary Protector: Bond to PBB with insulated bonding conductor.
 10. Electrical Power Panelboards: Where electrical panelboards for communications equipment are located in same room or space, bond each ground bar of panelboard to SBB.
 11. Cable Trays: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
 12. Ladder Racks: Provide continuous electrical path by installing bonding clips and jumpers. Bond each end to nearest SBB.
 13. Access Floors: Bond metal parts of access floors to SBB.

3.5 IDENTIFICATION

- A. Comply with Section 270553 "Identification for Communications Systems."
- B. Labels must be preprinted or computer-printed type.

1. Label PBB(s) with "ts-PBB," where "ts" is telecommunications space identifier for location of PBB.
2. Label SBB(s) with "ts-SBB," where "ts" is telecommunications space identifier for location of SBB.
3. Label TBC, TBBs, and BBCs at attachment points with legend: "WARNING! COMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench according to manufacturer's published instructions.
2. Test bonding connections of system using AC earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing PBB or SBB, using process recommended by BICSI N1. Conduct tests with facility in operation.
 - a. Measure resistance between PBB and electrical service intersystem termination point. Maximum acceptable value is 100 m Ω .
 - 1) If measured resistance from electrical service equipment to ground exceeds 5 Ω , notify Architect and include recommendations to reduce resistance to ground.
 - b. Measure resistance between SBBs and PBB. Maximum acceptable value is 100 m Ω .
3. Test for ground loop currents using digital clamp-on ammeter, with full scale not more than 10 A, displaying current in increments of 0.01 A at accuracy of plus or minus 2.0 percent.
 - a. With grounding infrastructure completed and communications system electronics operating, measure current in bonding conductors connected to PBB and to SBBs. Maximum acceptable AC current level is 1 A.

B. Nonconforming Work:

1. Communications bonding will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports.

3.7 PROTECTION

- A. After installation, protect busbars and conductors from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 270526

SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 communications identification products.
- B. Identification Schedule:
 - 1. Outlets: Scaled drawings indicating location and proposed designation.
 - 2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
 - 3. Racks: Scaled drawings indicating location and proposed designation.
 - 4. Patch Panels: Enlarged scaled drawings showing rack row, number, and proposed designations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 70 and TIA 606-B.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- D. 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.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Equipment Identification Labels:
 - 1. Black letters on a white field.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible labels with acrylic pressure-sensitive adhesive.
 - 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 - 2. Marker for Labels:
 - a. Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.
- C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
 - 1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.4 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4-inch (6.4-mm) grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inches (180 by 250 mm).

2.5 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch (5 mm).
 - 2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
 - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 - 4. Color: Black, except where used for color-coding.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying communications identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.
- G. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- H. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
 - 3. Provide label 6 inches (150 mm) from cable end.
- I. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

J. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

K. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:

- a. Telecommunications.

D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:

1. Wiring closet designation.
2. Colon.
3. Faceplate number.

E. Equipment Room Labeling:

1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
2. Patch Panels: Label individual rows and outlets, starting at to left and working down, with self-adhesive labels.
3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:
 - a. Room number being served.

- b. Colon.
 - c. Faceplate number.
- F. Backbone Cables: Label each cable with a vinyl-wraparound label or self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.
- G. Horizontal Cables: Label each cable with a vinyl-wraparound label or self-adhesive wraparound label indicating the following, in the order listed:
- 1. Room number.
 - 2. Colon.
 - 3. Faceplate number.
- H. Locations of Underground Lines: Underground-line warning tape for copper, coaxial, hybrid copper/fiber, and optical-fiber cable.
- I. Instructional Signs: Self-adhesive labels.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Baked-enamel warning signs.
- 1. Apply to exterior of door, cover, or other access.
- K. Equipment Identification Labels:
- 1. Indoor Equipment: Self-adhesive label.
 - 2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
 - 3. Equipment to Be Labeled:
 - a. Communications cabinets.
 - b. Uninterruptible power supplies.
 - c. Computer room air conditioners.
 - d. Fire-alarm and suppression equipment.
 - e. Egress points.
 - f. Power distribution components.

END OF SECTION 270553

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. RCDD: Registered communications distribution designer.
- D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- E. TGB: Telecommunications grounding bus bar.
- F. TMGB: Telecommunications main grounding bus bar.

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 equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
 - 2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

PART 2 - PRODUCTS

2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- I. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- J. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 POWER STRIPS

- A. Comply with requirements in Section 271116 "Communications Racks, Frames, and Enclosures."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.
 1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:

1. Install from 6 inches (150 mm) to 8 feet, 6 inches (2588 mm) above finished floor. If plywood is fire rated, ensure that fire-rating stamp is visible after installation.
2. Paint all sides of backboard with two coats of paint, leaving fire rating stamp visible.
3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

3.2 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices" Ch.

END OF SECTION 271100

SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

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 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. LAN: Local area network.
- D. RCDD: Registered communications distribution designer.
- E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- F. TGB: Telecommunications grounding bus bar.
- G. TMGB: Telecommunications main grounding bus bar.

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 equipment racks and cabinets.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.
- B. Shop Drawings: For communications racks, frames, and enclosures. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of TGB and its mounting detail showing standoff insulators and wall-mounting brackets.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
 2. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. UL listed.
- B. RoHS compliant.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.3 23-INCH EQUIPMENT RACKS

- A. Description: Two post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with 23-inch (584.2-mm) panel mounting.
- B. General Requirements:
 1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Finish: Manufacturer's standard, baked-polyester powder coat.
 3. Color: Black.
- C. Floor-Mounted Racks:
 1. Overall Height: 84 inches (2133.6 mm).
 2. Overall Depth: 23 inches (584.2 mm).
 3. Rail Depth: 3 inches (76.2 mm).
 4. Two-Post Load Rating: 400 lb (181 kg).

5. Number of Rack Units: 42.
6. Threads: Universal square.
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

D. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot (4.5-m) line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Peak Single-Impulse Surge Current Rating: 26 kA per phase.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Rack and Cabinet TGBs: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-606-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted TGB: Terminal block, with stainless-steel or copper-plated hardware for attachment to cabinet.

2. Rack-Mounted Horizontal TGB: Designed for mounting in 19- or 23-inch (482.6- or 584.2-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical TGB: 72 or 36 inches (1828.8 or 914.4 mm) long, with stainless-steel or copper-plated hardware for attachment to rack.

2.6 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout of communications equipment spaces.
- C. Comply with BICSI ITSIMM for installation of communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.
 1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
 2. Record agreements reached in meetings and distribute them to other participants.
 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 GROUNDING

- A. Comply with NECA/BICSI 607.

- B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Ch.
- C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches (50 mm) of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.
 - 1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

3.3 IDENTIFICATION

- A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."
- B. Labels shall be machine printed. Type shall be 3/16 inch (5 mm) in height.

END OF SECTION 271116

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Conductive Cable: Cable containing non-current-carrying electrically-conductive members such as metallic strength members and metallic vapor barriers.
- B. Cross-Connect: A facility enabling termination of cable elements and their interconnection or cross-connection.
- C. Types OFN and OFNG: Nonconductive cable for general purpose use.

1.2 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.

1.4 INFORMATIONAL SUBMITTALS

- A. Source Quality-Control Submittals:
 - 1. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For optical fiber cable, splices, and connectors.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish to Owner extra materials, from same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Include the following:
 - 1. Patch-Panel Units: One of each type.

2. Plugs: 10 of each type.
3. Jacks: 10 of each type.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet-work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.
- B. Test cables upon receipt at Project site.
 1. Test optical fiber cable while on reels. Use optical time domain reflectometer to verify cable length and locate cable defects, splices, and connector, including loss value of each. Retain test data and include record in maintenance data.

PART 2 - PRODUCTS

2.1 TYPES OFN AND OFNG OPTICAL FIBER CABLE

- A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing no electrically conductive materials.
- B. Performance Criteria:
 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 2. Listing Criteria: UL CCN QAYK; including UL 1651.
 3. General Characteristics:
 - a. Performance: TIA-568.3.
 - b. Inside Plant Mechanical Properties: ICEA S-83-596.
 - c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
 - d. Jacket:
 - 1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
 - 2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).
- C. Types OFN and OFNG, Designation OS1, Inside Plant, Single-Mode Optical Fiber Cable:
 1. Source Limitations: Obtain products from single manufacturer.
 2. Additional Characteristics:
 - a. Construction: TIA-492CAAA; 9 μ m core diameter, 125 μ m cladding diameter.

- b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
- 3. Options:
 - a. Configuration: 12 fibers, tight buffered, optical fiber cable.
 - b. Maximum Attenuation: 1.0 dB/km at 1310 nm wavelength; 1.0 dB/km at 1550 nm wavelength.
 - c. Jacket Color: Yellow.

2.2 TYPES OFC AND OFCG OPTICAL FIBER CABLE

- A. Description: This category covers jacketed optical fiber cable for general use within buildings in accordance with Article 770 of NFPA 70 containing noncurrent-carrying electrically conductive materials.
- B. Performance Criteria:
 - 1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - 2. Listing Criteria: UL CCN QAYK; including UL 1651.
 - 3. General Characteristics:
 - a. Performance: TIA-568.3.
 - b. Inside Plant Mechanical Properties: ICEA S-83-596.
 - c. Inside-Outside Plant Mechanical Properties: ICEA S-104-696.
 - d. Jacket:
 - 1) Cable cordage jacket, fiber, unit, and group color in accordance with TIA-598.
 - 2) Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inch (1 m).
- C. Types OFC and OFCG, Designation OS1, Inside Plant, Single-Mode Optical Fiber Cable:
 - 1. Source Limitations: Obtain products from single manufacturer.
 - 2. Additional Characteristics:
 - a. Construction: TIA-492CAAA; 9 μ m core diameter, 125 μ m cladding diameter.
 - b. Minimum Overfilled Modal Bandwidth-Length Product: 500 MHz-km at 850 nm wavelength; 500 MHz-km at 1300 nm wavelength.
 - 3. Options:
 - a. Configuration: 12 fibers, tight buffered, optical fiber cable.
 - b. Maximum Attenuation: 1.0 dB/km at 1310 nm wavelength; 1.0 dB/km at 1550 nm wavelength.
 - c. Jacket Color: Yellow.

- d. Armor: Steel.

2.3 OPTICAL FIBER CABLE HARDWARE

A. Performance Criteria:

1. Fiber Optic Connector Intermateability Standard (FOCIS) specifications of TIA-604 series.
2. TIA-568.3.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36 inch (900 mm) lengths.

D. Connector Type: Type LC complying with TIA-604-10, connectors.

E. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.

F. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of single optical fiber cable.
2. Insertion loss not more than 0.25 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to patch panel or faceplate.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections:

1. Test and inspect pre-terminated optical fiber cable assemblies, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with TIA-526-14 and TIA-568.3 before delivering to site. Affix label with name and date of manufacturer's certification of system compliance.

B. Nonconforming Work:

1. Cables that do not pass tests and inspections will be considered defective.

- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate backbone cabling with protectors and demarcation point provided by communications service provider.

3.2 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

- A. Optical fiber backbone cabling system must provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters may not be used as part of backbone cabling.
- C. Comply with BICSI N1, NECA NEIS 1, and NECA NEIS 301.
- D. Backbone cabling system must comply with transmission standards in TIA-568.1.
- E. Telecommunications Pathways and Spaces: Comply with TIA-569.
- F. Wiring Methods:
 - 1. In Raceway: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - a. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
 - 2. In Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
- G. Optical Fiber Cabling Installation:
 - 1. Comply with TIA-568.1 and TIA-568.3.
 - 2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
 - 3. Terminate all cables; no cable may contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inch (760 mm) and not more than 6 inch (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.
9. In communications equipment room, provide 10 ft (3 m) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
11. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

H. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable may not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

I. Group connecting hardware for cables into separate logical fields.

3.3 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569, Annex A, "Firestopping."
- C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.4 GROUNDING

- A. Install grounding in accordance with BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607 and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize length of bonding conductors. Fasten to wall allowing at least 2 inch (50 mm) clearance behind grounding bus bar. Connect grounding bus bar with minimum 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to grounding bus bar, using not smaller than 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

- B. Cable Schedule: Install in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish electronic copy of final comprehensive schedules for Project.

- C. Cable and Wire Identification:
 - 1. Label each cable within 4 inch (100 mm) of each termination and tap, where it is accessible in cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 ft (4.5 m).
 - 4. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use different color for jacks and plugs of each service.

- D. Labels must be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606, for the following:
 - 1. Flexible vinyl or polyester that flexes as cables are bent.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visually inspect optical fiber jacket materials for qualified electrical testing laboratory certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Optical Fiber Cable Tests:

- a. Test instruments must meet or exceed applicable requirements in TIA-568.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Link End-to-End Attenuation Tests:
 - 1) Attenuation test results for backbone links must be less than 2.0 dB. Attenuation test results must be less than those calculated in accordance with equation in TIA-568.1.

B. Nonconforming Work:

1. Cables will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective cables and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Data for each measurement must be documented.
2. Data for field quality-control report submittals must be printed in summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from instrument to computer, saved as text files, and printed and submitted.

END OF SECTION 271323

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

1.2 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors 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. Connecting Blocks: One of each type.
2. Cover Plates: One of each type.
3. Jacks: Ten of each type.
4. Patch-Panel Units: One of each type.
5. Plugs: Ten of each type.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.
 - 2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
 - 1. Communications, Plenum Rated:

- a. Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
 - b. Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
2. Communications, Non-Plenum Rated:
- a. Type CMR complying with UL 1666.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Plenum.
- F. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
 1. Comply with the performance requirements of Category 6.
 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

- D. Connecting Blocks:
 - 1. 110-style IDC for Category 6.
 - 2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.

- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 - 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 - 2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
 - 3. Number of Jacks per Field: One for each four-pair cable indicated.

- G. Patch Cords: Factory-made, four-pair cables in 36-inch (900-mm) lengths; terminated with an eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

- H. Plugs and Plug Assemblies:
 - 1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Standard: Comply with TIA-568-C.2.

- I. Jacks and Jack Assemblies:
 - 1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
 - 2. Designed to snap-in to a patch panel or cover plate.
 - 3. Standard: Comply with TIA-568-C.2.

- J. Cover Plate:
 - 1. Two or Four port, vertical single gang cover plates designed to mount to single gang wall boxes.
 - 2. Plastic Cover Plate: High-impact plastic. Coordinate color with Section 260533 "Raceway and Boxes for Electrical Systems."
 - 3. Metal Cover Plate: Stainless steel, complying with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."

4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

- A. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Routing:

1. Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.
 - a. Install plenum cable in environmental air spaces, including plenum ceilings.
 - b. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
2. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings."
- B. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
 - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
 - 5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 6. MUTOA shall not be used as a cross-connect point.
 - 7. Consolidation points may be used only for making a direct connection to equipment outlets:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for twisted-pair cables at least 49 feet (15 m) from communications equipment room.
 - 8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
 - 11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
 - 12. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 13. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
 - 14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Open-Cable Installation:
 - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - 2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- C. Comply with TIA-607-B and NECA/BICSI-607.
- D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.
- E. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
 - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Cable and Wire Identification:
 - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.

- b. Label each unit and field within distribution racks and frames.
- 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- C. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
 - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- C. Nonconforming Work:
 - 1. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- D. Collect, assemble, and submit test and inspection reports.

END OF SECTION 271513