PROJECT MANUAL

FOR

231 CARONDELET

PROJECT NUMBER: 25008

OWNER: 231-233 CARONDELET UNIT 1, LLC

231 CARONDELET, UNIT 1
NEW ORLEANS , LOUISIANA 70130

DATE: SEPTEMBER 8, 2025

PREPARED BY:

STUDIO WEST DESIGN & ARCHITECTURE, LLC

STATUS: CONSTRUCTION DOCUMENTS

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SECTION 00 31 00
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:

B. Historical Construction Documents: Construction Drawings entitled New Cotton Exchange, dated March 30, 1920, prepared by Favrot & Livaudais Architects; 47 pages.
   1. Drawings have not been reviewed by Owner or Architect for accuracy of exisitng conditions, or subsequent modifications to the building, and are provided for convenience in preparing bids.

C. Historical Construction Documents; Construction Drawings entitled Holiday Inn Express at the Cotton Exchange, dated March 5, 2001, prepared by Willams & Associates Architects; 188 pages.
   1. Drawings have not been reviewed by Owner or Architect for accuracy of exisitng conditions, or subsequent modifications to the building, and are provided for convenience in preparing bids.

D. Historical Construction Documents; Construction Drawings entitled AC Hotel by Marriott Cotton Exchange Hotel, dated May 30, 2014, prepared by Campo Architects; 6 pages (a portion of the full set).
   1. Drawings have not been reviewed by Owner or Architect for accuracy of exisitng conditions, or subsequent modifications to the building, and are provided for convenience in preparing bids.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 OBTAINMENT OF PERMITS

A. Owner will obtain the following permits, at no cost to the Contractor:
   1. State Fire Marshal Plan Review.
   2. Louisiana Department of Health Plan Review for first floor restaurant.
   3. City of New Orleans Building Permit.

B. Contractor to obtain the following required permits, at no cost to Owner:
   1. Trade-specific Building Permits for all trades.
      a. Initial application for Building Permit will be submitted by Architect. Building permit requires fully authorized Contract be transmitted to New Orleans Department of Safety and Permits.
      b. Contractor shall submit and obtain all other building permits.

C. Building Permit Procedures:
   1. Complete and file permit application(s) with appropriate agency.
      a. Submit applications within 14 days of the Notice to Proceed.
   2. Pay required fees.
   3. Advise Architect if submission of modified documents is necessary to have the authorities having jurisdiction complete the plan review and approval process. Submit modified documents expeditiously.
   4. Do not commence execution of any item of work for which a permit has not been obtained.

END OF SECTION 00 31 00

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SECTION 00 50 00
CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

1.01 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. The Agreement is based on AIA A101.

B. The General Conditions are based on AIA A201.
   1. Builder's Risk Insurance shall be paid by Contractor.

1.02 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.

B. Post-Award Certificates and Other Forms:
   1. Schedule of Values Form: AIA G703.
   2. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).

C. Clarification and Modification Forms:
   1. Substitution Request Form: CSI/CSC Form 1.5C (During the Bidding/Negotiating Stage).
   2. Substitution Request Form: CSI/CSC Form 13.1A (After the Bidding/Negotiating Stage).
   3. Architect's Supplemental Instructions Form: AIA G710.
   4. Construction Change Directive Form: AIA G714.
   5. Work Changes Proposal Request Form: AIA G709-2001.
   6. Change Order Form: AIA G701.

D. Closeout Forms:
   1. Certificate of Substantial Completion Form: AIA G704.

1.03 REFERENCE STANDARDS

A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum; 2017.

B. AIA A201 - General Conditions of the Contract for Construction; 2017.

C. AIA G701 - Change Order; 2017.

D. AIA G702 - Application and Certificate for Payment; 1992.

E. AIA G703 - Continuation Sheet; 1992.

F. AIA G704 - Certificate of Substantial Completion; 2017.

G. AIA G709-2001 - Proposal Request; 2001.

H. AIA G710 - Architect's Supplemental Instructions; 2017.

I. AIA G714 - Construction Change Directive; 2017.

J. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

K. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 00 50 00

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SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: 231 Carondelet

B. Owner's Name: 231-233 Carondelet Unit 1, LLC.

C. Architect's Name: Studio West.

D. The Project consists of the alteration of two floors of the existing Cotton Exchange Building at 231-233 Carondelet.
   1. The Work is to be performed to the condominium owned by 231-233 Carondelet Unit 1, LLC.
   2. The Work will require modifications to existing building systems in the basement of the building, as well as adjacent building spaces owned by another entity and operated by Marriott AC Hotel.

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a stipulated sum.
   1. Renovation costs for the Work shall be divided between the first and second floors for all proposals, payment applications and changes to the contract.

1.03 DESCRIPTION OF ALTERATIONS WORK

A. Scope of demolition and removal work is indicated on drawings and specified in Section 02 41 00.

B. Scope of alterations work is indicated on drawings.

C. Plumbing:
   1. Plumbing: Alter existing system and add new construction, keeping existing in operation.

D. HVAC:
   1. HVAC: Alter existing system and add new construction, keeping existing in operation.

E. Electrical Power and Lighting:
   1. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.

F. Fire Alarm:
   1. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.

G. Communications:
   1. IT Cabling and Infrastructure: Replace existing system with new construction, keeping existing in operation until ready for changeover.

H. Security System:
   1. Security System: Replace existing system with new construction, keeping existing in operation until ready for changeover.

I. Owner will remove the following items before start of work:
   1. Office furnishings.

1.04 WORK BY OWNER

A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Date of Substantial Completion. Some items include:
   1. Residential Appliances
   2. Movable furnishings.
   3. Artwork.
   4. Network gateway and router.

1.05 OWNER OCCUPANCY

A. Owner and the Hotel will occupy site and existing buildings during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as to not interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Owner will relocate operations of the second floor office prior to the commencement of Work in that area.
2. Maintain access to existing common alley, corridors, or other occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner.
3. Provide not less than 72 hour notice to Owner of activities that will affect Owner's operations.

B. Owner reserves the right to occupy and to place and install equipment in completed areas of new construction, before Substantial Completion, provided that such occupancy does not interfere with completion of work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total work.
1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain Certificate of Occupancy from authorities having jurisdiction before owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be succesfully completed. On occupancy, Owner will operate and maintain mechanical and electrical system serving occupied portions of the building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

C. Owner intends to occupy the Project upon Substantial Completion.

1.06 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.
1. Driveways and Entrances: The construction operations of the Contractor may not cause any obstruction to the free flow of traffic on the streets or sidewalks. Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's Employees, and emergency vehicle at all times. Do not use these areas for parking or storage of materials.
   a. Schedule deliveries to minimze use of driveways and entrances.
   b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.
   c. Schedule deliveries to occur within Tulane's working hours as defined by this project manual.
   d. Coordinate large or multiple deliveries with the Owner at least 72 hours in advance.
   e. Contractor will insure that vendors are instructed to utilize site access routes as allowed by the authority having jurisdiction and the campus police department.
   f. The Owner strictly prohibits the use of Audubon Boulevard, Calhoun Street, and Palmer Avenue by any vehicles or equipment associated with this project.

B. Arrange use of site and premises to allow:
1. Owner occupancy.
2. Work by Others.
3. Work by Owner.
4. Use of site and premises by the public.

C. Provide access to and from site as required by law and by Owner:
1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Existing building spaces may be used for storage.

E. Time Restrictions:

F. Utility Outages and Shutdown:
1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
2. Limit shutdown of utility services to four hours at a time, arranged at least 24 hours in advance with Owner.
3. Prevent accidental disruption of utility services to other facilities.

1.07 WORK SEQUENCE

A. Coordinate construction schedule and operations with Owner.

1.08 GENERAL CONDITIONS AND SPECIFICATION SECTIONS APPLICABLE TO EVERY SECTION

A. Unless otherwise noted, provisions of the sections listed below apply to the Work and every Section within this project manual, whether or not explicitily stated within each Section.
   1. Document 00 72 00 - General Conditions.
   2. Section 01 20 00 - Price and Payment Procedures.
   3. Section 01 21 00 - Allowances.
   4. Section 01 23 00 - Alternates.
   5. Section 01 25 00 - Substitution Procedures.
   6. Section 01 30 00 - Administrative Requirements.
   7. Section 01 40 00 - Quality Requirements.
   8. Section 01 42 16 - Definitions.
   9. Section 01 42 19 - Reference Standards.
   10. Section 01 50 00 - Temporary Facilities and Controls.
   11. Section 01 60 00 - Product Requirements.
   12. Section 01 70 00 - Execution and Closeout Requirements.
   13. Section 01 78 00 - Closeout Submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 10 00

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SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.

I. Submit one electronic and three hard-copies of each Application for Payment.

J. Include the following with the application:
   1. Transmittal letter as specified for submittals in Section 01 30 00.
   2. Construction progress schedule, revised and current as specified in Section 01 30 00.
   3. Partial release of liens from major subcontractors and vendors.
   4. Affidavits attesting to off-site stored products.

K. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.05 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required . Contractor shall prepare and submit a fixed price quotation within 21 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 60 00.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
   1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
   2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
   3. For pre-determined unit prices and quantities, the amount will based on the fixed unit prices.
   4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. Provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Taxes, insurance, and bonds.
      c. Overhead and profit.
      d. Justification for any change in Contract Time.
      e. Credit for deletions from Contract, similarly documented.
   2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

I. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.

B. Application for Final Payment will not be considered until the following have been accomplished:
   1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 20 00

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.

B. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.04 REFERENCE STANDARDS

A. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage); Current Edition.

B. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase); Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
   1. Note explicitly any non-compliant characteristics.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item, or collection of items included in a single Section.
   1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Form (before award of contract):

1. Submit substitution requests by completing CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage). See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Owner will consider requests for substitutions only if submitted at least seven (7) days prior to the date for receipt of bids.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
   1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Architect will consider requests for substitutions only within 30 days after date of Agreement.

C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
   1. Substitution for Convenience will not be considered during construction.

D. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. Include completed Substitution Request Forms as part of the Project record.

3.07 ATTACHMENTS

A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.

END OF SECTION 01 25 00

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Progress meetings.

E. Contractor's daily reports.

F. Progress photographs.

G. Coordination drawings.

H. Submittals for review, information, and project closeout.

I. Number of copies of submittals.

J. Requests for Interpretation (RFI) procedures.

K. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements: General product requirements.

B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.03 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

B. Make the following types of submittals to Architect:
   1. Requests for Interpretation (RFI).
   2. Requests for substitution.
   3. Shop drawings, product data, and samples.
   4. Test and inspection reports.
   5. Design data.
   6. Manufacturer's instructions and field reports.
   7. Applications for payment and change order requests.
   8. Progress schedules.
   9. Coordination drawings.
   10. Correction Punch List and Final Correction Punch List for Substantial Completion.
   11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
   2. Contractor and Architect are required to use this service.

3. It is Contractor's responsibility to submit documents in allowable format.
4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.

C. Submittal Service: Use one of the following:
1. Submittal Exchange: www.submittalexchange.com/.
2. Newforma ConstructEx: www.newforma.com/products/constructex/.
3. Procore: www.procore.com.
4. Centerline: www.centerline.co.

D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
1. Representatives of Owner are scheduled and included in this training.

E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Architect will schedule a meeting after Notice of Award.

B. Attendance Required:
1. Owner.
2. Architect.
3. Contractor.

C. Agenda:
1. Execution of Owner-Contractor Agreement.
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of subcontractors, schedule of values, and progress schedule.
5. Submission of initial Submittal schedule.
6. Designation of personnel representing the parties to Contract, Operator and Architect.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum weekly intervals.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required:
1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

D. Agenda:

1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Maintenance of quality and work standards.
11. Effect of proposed changes on progress schedule and coordination.
12. Other business relating to work.

E. Record minutes and distribute copies within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.

B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

D. Within 10 days after joint review, submit complete schedule.

E. Submit updated schedule with each Application for Payment.

3.05 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
   1. Date.
   2. High and low temperatures, and general weather conditions.
   3. List of subcontractors at Project site.
   4. Approximate count of personnel at Project site.
   5. Major equipment at Project site.
   6. Material deliveries.
   7. Safety, environmental, or industrial relations incidents.
   8. Meetings and significant decisions.
   9. Unusual events (submit a separate special report).
   10. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
   11. Testing and/or inspections performed.
   12. Signature of Contractor's authorized representative.

3.06 PROGRESS PHOTOGRAPHS

A. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.

B. Photography Type: Digital; electronic files.

C. In addition to periodic, recurring views, take photographs of each of the following events:
   1. Excavations in progress.
   2. Foundations in progress and upon completion.
   3. Structural framing in progress and upon completion.
   4. Enclosure of building, upon completion.

D. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.

3.07 COORDINATION DRAWINGS

A. Review drawings prior to submission to Architect.

3.08 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
   1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
   2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.

C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
   1. Prepare a separate RFI for each specific item.
      a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
      b. Do not forward requests which solely require internal coordination between subcontractors.
   2. Prepare using software provided by the Electronic Document Submittal Service.
   3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.

D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
   1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
   2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
      a. Approval of submittals (use procedures specified elsewhere in this section).
      b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
   3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
   4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.

E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
   1. Official Project name and number, and any additional required identifiers established in Contract Documents.
   2. Owner's, Architect's, and Contractor's names.
   3. Discrete and consecutive RFI number, and descriptive subject/title.
   4. Issue date, and requested reply date.
   5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
   6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
   7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances,

and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
   1. Indicate current status of every RFI. Update log promptly and on a regular basis.
   2. Note dates of when each request is made, and when a response is received.
   3. Highlight items requiring priority or expedited response.

H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
   1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.

3.09 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Coordinate with Contractor's construction schedule and schedule of values.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.10 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.11 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.14 SUBMITTAL PROCEDURES

A. General Requirements:
   1. Use a separate transmittal for each item.
   2. Transmit using approved form.
      a. Use form generated by Electronic Document Submittal Service software.
   3. Sequentially identify each item. For revised submittals use original number and a sequential combination numberical and alphabetical suffix.
   4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
   5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
      a. Upload submittals in electronic form to Electronic Document Submittal Service website.
   6. Schedule submittals to expedite the Project, and coordinate submission of related items.
      a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
      b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 14 days.
      c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
   7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
   8. Provide space for Contractor and Architect review stamps.
   9. When revised for resubmission, identify all changes made since previous submission.
   10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
   11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
   12. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
   1. Submit only information required by individual specification sections.
   2. Collect required information into a single submittal.
   3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
   1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
   2. Do not reproduce Contract Documents to create shop drawings.

3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
3. Include with transmittal high-resolution image files of samples to facilitate electronic review and approval. Provide separate submittal page for each item image.

3.15 SUBMITTAL REVIEW

A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.

B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.

C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.

D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
a. "Approved", or language with same legal meaning.
b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
2. Not Authorizing fabrication, delivery, and installation:
a. "Revise and Resubmit".
1) Resubmit revised item, with review notations acknowledged and incorporated.
2) Non-responsive resubmittals may be rejected.
b. "Rejected".
1) Submit item complying with requirements of Contract Documents.

E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:
a. "No Action Taken - Information Only" - to notify the Contractor that the submittal has been received for record only.
2. Items for which action was taken:
a. "Reviewed" - no further action is required from Contractor.

END OF SECTION 01 30 00

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SECTION 01 35 91
PERIOD TREATMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction procedures appropriate for working with historic sites and structures.

B. Special procedures required for items and features of historical significance and value requiring special treatment.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, and work sequence.

B. Section 02 41 00 - Demolition: Selective demolition of nonhistoric elements.

1.03 DEFINITIONS

A. Consolidate: Strengthen loose or deteriorated materials in situ.

B. Dismantle: Disassemble and detach items by hand from existing construction to the limits indicated, using small hand tools and small one-hand power tools, to protect nearby historic surfaces, and legally dispose of dismantled items off-site, unless indicated to be salvaged or reinstalled.

C. Existing to Remain: Existing items that are not to be removed or dismantled. Protect materials as indicated.

D. Historic: Spaces, areas, rooms, surfaces, materials, finishes, and overall appearance subject to rehabilitation procedures defined in NPS (THP). Designation “HF” and words such as “historic,” “historic fabric,” “historic materials,” “historic building materials,” 'historic character,' or words of similar meaning indicate that the material or feature is considered to have aspects that require period treatment procedures.

E. Historic Preservation Conservator: Person or firm retained by Owner to provide guidance on compliance with NPS (THP) requirements.

F. In-Kind: Matching existing in physical and visual aspects including, but not limited to, material, form, color, texture, and workmanship.

G. Matching: Blending with adjacent construction and showing no apparent difference in material type, form, detail, color, texture, finish, or other visible and readily discernible characteristics, as determined and approved by Architect.

H. Preserve: Apply measures to sustain existing form, integrity, and materials of a historic property; may include preliminary measures to protect and stabilize the property.

I. Protect: Take precautions to keep historic materials of the building from damage or injury.

J. Reconstruct: Remove existing item, refurbish existing or replicate damaged or missing components as indicated or directed, and reinstall in original position.

K. Refinish: Remove existing finishes from base material and apply new finish to match original or as otherwise indicated.

L. Remove: Detach or dismantle items from existing construction and dispose of them off-site, unless items are indicated to be salvaged or reinstalled.

M. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall in original location or in other location where indicated.

N. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label, and deliver salvaged items to Owner in ready-for-reuse condition.

O. Repair: Correct damage and defects, retaining existing materials, features, and finishes and employing as few new materials as possible. Includes patching, piecing-in, splicing, consolidating, or reinforcing or upgrading materials with appropriate and approved materials and methods.

P. Replace: Remove, duplicate, and reinstall entire item with new material. Use original item as the pattern unless noted otherwise.

Q. Replicate or Reproduce: Fabricate a new item in exact detail, materials, and finish as the original, unless otherwise indicated; referred to as replicas or reproductions.

R. Restore: Return to original condition; return to the condition extant during the period of interpretation.

S. Retain: Existing to remain; keep existing items that are not to be removed or dismantled.

T. Reversible: New construction work, treatment, or processes that can be removed or undone in the future without damaging historic materials.

U. Stabilize: Provide reinforcement of unsafe or deteriorated items and maintain the present, essential form; reestablish weather-resistant enclosure.

V. Strip: Remove existing finish down to base material, unless otherwise indicated.

1.04 REFERENCE STANDARDS

A. NPS (THP) - The Secretary of The Interior's Standards For the Treatment of Historic Properties with Guidelines For Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings; 2017.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Quality Control Submittals:
   1. Practices and Treatments: Use NPS (THP) recommendations as a general guide for proposed practices and treatments, modified as necessary to suit project requirements and conditions.

C. Project Record Documents:
   1. Record of conditions encountered before, during, and after completion of work.
   2. Types and locations of identification and labels of new or replacement materials and features.

1.07 QUALITY ASSURANCE

A. Owner has employed a historic preservation conservator to advise the project team.

1.08 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Arrange for one or more demonstration mock-ups, using each type of proposed cleaning, repairing, and refinishing materials and methods.

C. Locate where directed.

D. Mock-ups may remain as part of the work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:
   1. Use and reuse materials original to the existing structure wherever practical. Store removed materials under cover, inside, and protect from damage.
   2. Label specific pieces or items to be removed. Label consistently and inconspicuously indicating original location, and document original position.
   3. Protect materials during storage and construction from rain, snow, or groundwater and from soiling with earth or other materials.
      a. Store cementitious materials off ground, under cover, and in a dry location. Protect liquid components from freezing.
      b. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.
   4. Store restoration and cleaning chemicals off-site or in metal cabinets on-site. Do not leave cans open or out of the cabinet overnight. Do not store in unlabeled containers.

1.10 FIELD CONDITIONS

A. Environmental Requirements:
   1. Wet or Humid Weather:
      a. Do not remove exterior elements of structures when raining or rain is forecasted.

b. Do not repair exterior features in rain or fog.

B. Exterior Cleaning Procedures: Perform cleaning and rinsing of the exterior elements only during daylight hours.

C. Protection of Existing Elements: In accordance with manufacturer's recommendations for use of proposed products and procedures and compatibility with adjacent historic building materials, components, and vegetation.

PART 2 - PRODUCTS

2.01 PROTECTION PRODUCTS

A. Adhesive Walk-Off, Tacky Mats: Mats with multiple layers of disposable, adhesive-coated sheets.

2.02 CLEANING MATERIALS

A. General: Do not use incompatible materials that may contribute to damage of the element being cleaned.

B. Use products specifically intended by the manufacturer for cleaning historic materials or elements.

2.03 REPAIR MATERIALS

A. General: Do not use incompatible materials contributing to damage of repaired elements.

B. Matching: Unless otherwise required, use new materials that match historic materials in type, design, dimension, texture, detailing, and external appearance.

2.04 REFINISHING MATERIALS

A. General: Do not use incompatible materials that may contribute to damage of the element being refinished.

B. Matching: Unless otherwise required, use new materials that match historic materials in type, design, texture, detailing, and external appearance.

PART 3 - EXECUTION

3.01 PREPARATION

A. Dismantling: Follow the reverse order of original construction to the extent practicable.

3.02 PERIOD TREATMENT SPECIAL PROCEDURES

A. Review proposed procedures for each type of element with Architect. Obtain approval from Historic conservator before commencing work.

B. Salvage as much existing material of each element as practicable; repair, consolidate, and restore rather than renew.

C. Repair rather than replace architectural features wherever possible. Repair or replace missing features with accurate duplications.

D. Document condition of items being worked on before, during, and after work is completed.

E. Protect existing materials and substrates from damage.

F. Protect existing elements and features removed, cleaned, and reused from material damage.
1. Label salvaged items and features and store at project site, in designated location; protect from damage.

G. Exterior Work Procedures: Protect parts of the facility not included in this work from damage.
1. Protect adjacent property from damage from this work.
2. Do not attach scaffolding, ladders, and working platforms to building unless approved in writing by the Architect.
3. Test drain systems to assure proper functioning before performing cleaning operations. Notify Owner if stopped or blocked.
4. Seal exterior openings to prevent entry of dust, debris, and water into the building.
5. Protect landscape work adjacent to or within period treatment work areas:
   a. Set scaffolding and ladder legs away from plants. Submit pruning requests to Architect.
   b. Use covering methods and materials that allow plants to breathe. Remove covering at the end of each workday. Do not cover plant material with a waterproof membrane for more than 8 hours at one time.

H. Interior Work Procedures: Protect parts of the facility not being cleaned or repaired from effects of this work.
   1. Provide enclosures to protect against spread of dust, debris, and water at or beyond the work area.
   2. Mask or cover adjacent surfaces and permanent equipment. Secure coverings; do not use adhesive type tape or nails. Do not use impervious sheeting.

END OF SECTION 01 35 91

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. Quality assurance.

C. References and standards.

D. Testing and inspection agencies and services.

E. Contractor's construction-related professional design services.

F. Contractor's design-related professional design services.

G. Control of installation.

H. Mock-ups.

I. Tolerances.

J. Manufacturers' field services.

K. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittal procedures.

B. Section 01 42 16 - Definitions.

C. Section 01 42 19 - Reference Standards.

D. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2020.

1.03 DEFINITIONS

A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
   1. Design Services Types Required:
      a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor’s sole responsibilities for construction means, methods, techniques, sequences, and procedures.
      b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.

C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.04 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
   1. Temporary sheeting, shoring, or supports.
   2. Temporary bracing.
   3. Temporary stairs or steps required for construction access only.
   4. Temporary hoist(s) and rigging.

1.05 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.

B. Base design on performance and/or design criteria indicated in individual specification sections.

C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
   1. Concrete Mix Design: As described in Section 03 30 00 - Cast-in-Place Concrete. No specific designer qualifications are required.
   2. Structural Design: Include physical characteristics, engineering calculations, and resulting dimensional limitations as described in Section 08 43 13 - Aluminum-Framed Storefronts.
   3. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Fire Protection Drawings.
   4. Other Design Components listed in individual sections..

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
   1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
   2. Include required product data and shop drawings.
   3. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.

C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
   1. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.

D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit report in duplicate within 30 days of observation to Architect for information.
   2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

G. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.07 QUALITY ASSURANCE

A. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State of Louisiana.

1.08 REFERENCES AND STANDARDS

A. Obtain copies of standards where required by product specification sections.

1.09 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform specified testing and inspection.

B. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.

C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Contractor Employed Agency:
   1. Testing agency: Comply with requirements of ASTM E329.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 MOCK-UPS

A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.

B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.

C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.

D. Room Mock-ups: Construct room mock-ups as indicated on drawings. Coordinate installation of materials, products, and assemblies as required in specification sections; finish according to requirements. Provide required lighting and any supplemental lighting where required to enable Architect to evaluate quality of the mock-up.

E. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.

F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.

G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
   1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
   2. Make corrections as necessary until Architect's approval is issued.

I. Architect will use accepted mock-ups as a comparison standard for the remaining Work.

J. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

3.04 TESTING AND INSPECTION

A. See individual specification sections for testing and inspection required.

B. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests/inspections specified.

C. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

D. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.06 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION 01 40 00

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SECTION 01 42 16
DEFINITIONS

PART 1 GENERAL

2.01 SUMMARY

A. This section supplements the definitions contained in the General Conditions.

B. Other definitions are included in individual specification sections.

2.02 DEFINITIONS

A. Demolish: same definition as remove.

B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

C. Furnish: To supply, deliver, unload, and inspect for damage.

D. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.

E. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.

F. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.

G. Provide: To furnish and install.

H. Remove: Detach items from existing construction and legally deispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

I. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

J. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

K. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 42 16

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SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements relating to referenced standards.

B. Reference standards full title and edition date.

1.02 QUALITY ASSURANCE

A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Comply with the reference standard of date of issue specified in the individual specification sections, except where a specific date is established by applicable code.

C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.

D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 NOT USED

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

END OF SECTION 01 42 19

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SECTION 01 45 33
CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Code-required special inspections.

B. Testing services incidental to special inspections.

1.02 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements.

B. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 ABBREVIATIONS AND ACRONYMS

A. AHJ: Authority having jurisdiction.

B. IAS: International Accreditation Service, Inc.

C. NIST: National Institute of Standards and Technology.

1.04 DEFINITIONS

A. Code or Building Code: ICC (IBC)-2015, Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.

B. 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.

C. Special Inspection:
   1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
   2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.05 REFERENCE STANDARDS

A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2018).

B. AISC 360 - Specification for Structural Steel Buildings; 2022.

C. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2020.

D. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.

E. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.

F. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.

G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SDI QA/QC - Standard for Quality Control and Quality Assurance for Installation of Steel Deck; 2022.

1.06 SPECIAL INSPECTION AGENCY

A. Owner or Architect will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.

B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.

C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES

A. Owner or Architect may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.

B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.08 QUALITY ASSURANCE

A. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
   1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
   2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved Contract Documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.

B. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI 318, Chapter 4 and 5.2; periodic.

C. Specified Curing Temperature and Techniques: Verify compliance with approved Contract Documents and ACI 318, Sections 5.11 through 5.13; periodic.

D. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI 318, Section 6.2, for the following.

3.03 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS

A. Verify penetration firestops in accordance with ASTM E2174.

B. Verify fire resistant joints in accordance with ASTM E2393.

3.04 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified reference standards.
   3. Ascertain compliance of materials and products with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
   5. Perform additional tests and inspections required by Architect.
   6. Submit reports of all tests or inspections specified.

B. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.05 TESTING AGENCY DUTIES AND RESPONSIBILITIES

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.

4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
5. Perform additional tests and inspections required by Architect.
6. Submit reports of all tests or inspections specified.

B. Limits on Testing or Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the work.

C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.

D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.06 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
3. Provide incidental labor and facilities:
a. To provide access to work to be tested or inspected.
b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
c. To facilitate tests or inspections.
d. To provide storage and curing of test samples.
4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

END OF SECTION 01 45 33

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary sanitary facilities.

D. Temporary Controls: Barriers, enclosures, and fencing.

E. Security requirements.

F. Vehicular access and parking.

G. Waste removal facilities and services.

H. Field offices.

1.02 TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Electrical power and metering, consisting of connection to existing facilities.
   2. Water supply, consisting of connection to existing facilities.

B. Existing facilities may be used.

C. New permanent facilities may be used.

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
   2. Internet Connections: Minimum of one; Cable modem or faster.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

E. Traffic Controls: Provide during utility work that requires access to the public street. Coordinate with Authorities Having Jurisdiction..

1.06 FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 foot (1.8 m) high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 INTERIOR ENCLOSURES

A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
   1. STC rating of 35 in accordance with ASTM E90.

C. Paint surfaces exposed to view from Owner-occupied areas.

1.09 SECURITY

A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

B. Coordinate with Owner's security program.

1.10 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.11 WASTE REMOVAL

A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

B. Provide containers with lids. Remove trash from site periodically.

C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.12 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table. Field Office may be located within existing first floor space.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet (10 m) from existing and new structures.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 50 00

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General product requirements.

B. Re-use of existing products.

C. Transportation, handling, storage and protection.

D. Product option requirements.

E. Substitution limitations.

F. Procedures for Owner-supplied products.

G. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Lists of products to be removed from existing building.

B. Section 01 10 00 - Summary: Identification of Owner-supplied products.

C. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

D. Section 01 40 00 - Quality Requirements: Product quality monitoring.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is not prohibited.

1. See Section 01 10 00 for list of items required to be salvaged for reuse and relocation.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. See Section 01 40 00 - Quality Requirements, for additional source quality control requirements.

C. Use of products having any of the following characteristics is not permitted:

1. Containing cadmium or asbestos.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

B. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Provide protection of stored materials and products against theft, casualty, or deterioration.

B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

C. Store and protect products in accordance with manufacturers' instructions.

D. Store with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Prevent contact with material that may cause corrosion, discoloration, or staining.

K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION 01 60 00

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SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Surveying for laying out the work.

F. Cleaning and protection.

G. Starting of systems and equipment.

H. Demonstration and instruction of Owner personnel.

I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 50 00 - Temporary Facilities and Controls: Temporary exterior enclosures.

C. Section 01 50 00 - Temporary Facilities and Controls: Temporary interior partitions.

D. Section 01 79 00 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

E. Section 07 84 00 - Firestopping.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
   1. On request, submit documentation verifying accuracy of survey work.
   2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
   3. Submit surveys and survey logs for the project record.

C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

D. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

E. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

A. For surveying work, employ a land surveyor registered in the State of Louisiana and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an

Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

B. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State of Louisiana.

1.06 PROJECT CONDITIONS

A. Use of explosives is not permitted.

B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

D. Perform dewatering activities, as required, for the duration of the project.

E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
   2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.

H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
   1. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.

I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.07 COORDINATION

A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Notify affected utility companies and comply with their requirements.

C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

F. Coordinate completion and clean-up of work of separate sections.

G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.

F. Utilize recognized engineering survey practices.

G. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.

H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

I. Periodically verify layouts by same means.

J. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.
   2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
   2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.

3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
    a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
    b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

J. Clean existing systems and equipment.

K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

L. Do not begin new construction in alterations areas before demolition is complete.

M. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Alterations article above for additional requirements.

C. Perform whatever cutting and patching is necessary to:
1. Complete the work.
2. Fit products together to integrate with other work.
3. Provide openings for penetration of mechanical, electrical, and other services.
4. Match work that has been cut to adjacent work.
5. Repair areas adjacent to cuts to required condition.
6. Repair new work damaged by subsequent work.
7. Remove samples of installed work for testing when requested.
8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

A. See Section 01 79 00 - Demonstration and Training.

3.12 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and building sewer.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Owner will occupy portions of the building as specified in Section 01 10 00.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

I. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION 01 70 00

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SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and maintenance data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

3. Field changes of dimension and detail.
4. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
   1. Description of unit or system, and component parts.
   2. Identify function, normal operating characteristics, and limiting conditions.
   3. Include performance curves, with engineering data and tests.
   4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Where systems involve more than one specification section, provide separate tabbed divider for each system.

C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.

F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.

G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.

H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.

I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

J. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Operation and maintenance data.

c. Field quality control data.
d. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.

F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.

H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 78 00

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SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.

B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Commissioning Authority for review and inclusion in overall training plan.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.
   2. Label each disc and container with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.
   2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
   1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.

5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
6. Discuss common troubleshooting problems and solutions.
7. Discuss any peculiarities of equipment installation or operation.
8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
9. Review recommended tools and spare parts inventory suggestions of manufacturers.
10. Review spare parts and tools required to be furnished by Contractor.
11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION 01 79 00

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SECTION 02 03 42
REMOVAL AND SALVAGE OF PERIOD CONSTRUCTION MATERIALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work includes deconstruction and salvage of identified historic items and materials and removal of rubbish and debris.

B. Specified procedures required for preservation, rehabilitation, restoration, and reconstruction treatment areas.

C. Historic items and materials are indicated on drawings. Wood flooring is Future Work at second floor.

1.02 RELATED REQUIREMENTS

A. Section 01 35 91 - Period Treatment Procedures for general historic preservation project requirements.

B. Section 02 41 00 - Demolition: Selective demolition of nonhistoric, built site elements.

C. Section 02 41 00 - Demolition: Selective demolition of nonhistoric building elements for alteration purposes.

1.03 DEFINITIONS

A. Debris: Nonhistoric building materials and contents destroyed during demolition.

B. Deconstruction: Systematic dismantling and removal of a structure or its parts and salvage of elements and components for reuse, recycling, and retaining maximum value.

1.04 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Work Plan: Detailed, proposed instructions for each type of operation of procedures for accomplishment of deconstruction work, including detailed description of the methods and equipment to be used and sequence of operations. Include the following:

1. Extent of deconstruction, removal sequences, temporary and permanent bracing and shoring, and location and construction of barricades.
2. Dust control measures.
3. Protection of property to remain undisturbed.
4. Ensure coordination with other work.

1.06 QUALITY ASSURANCE

A. Deconstruction Crew Qualifications: Workers trained and experienced in removal and salvage of historic materials.

1.07 FIELD CONDITIONS

A. Protection of Existing Historic Property: Before beginning removal, salvage, or demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damage to existing items to remain in place, be reused, or remain Owner's property. Repair or restore to original condition items damaged by Contractor, using approved means, methods, and techniques. Replace items that cannot be successfully repaired or restored to original condition.

B. Store materials to be salvaged or recycled daily, out of contact with the ground, under weathertight covering, in areas designated by Owner, and in the manner direct by Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PERIOD TREATMENT, GENERAL

A. See Section 01 35 91 for special procedure requirements related to elements and features of historical significance and value.

3.02 GENERAL PROCEDURES

A. Drawings indicating existing construction, building services, and site utilities are based on casual field observation and existing record documents only.
   1. Verify that construction, building services, and site utilities arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing historic elements.
   3. Beginning of work constitutes acceptance of existing conditions that are apparent upon examination at that time.

B. Separate spaces in which removals and salvage operations are conducted from occupied spaces.
   1. Provide, erect, and maintain temporary dustproof partitions; see Section 01 50 00.

C. See Section 02 41 00 for selective demolition of nonhistoric elements.

3.03 ENVIRONMENTAL CONTROLS

A. Comply with federal, state, and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment, and noise pollution.

3.04 ITEMS TO BE SALVAGED

A. General: Salvage elements and components to the maximum extent possible. Maintain a chain of custody of salvaged materials, including the condition of such materials before and after salvage operations.
   1. Remove historic items to be salvaged from the structure prior to deconstruction work.
   2. Accomplish removal of salvageable items by hand labor to the maximum extent possible.
   3. Take care not to damage historic portions of the structure scheduled to remain or items identified for salvage.

B. Masonry Elements: Remove intact and salvage stone that cannot be repaired in-place.

C. Finishes: Protect special or historic finishes and finish elements indicated on drawings, molded ornaments, and decorative ceiling materials. Remove and salvage plaster components as required to create molds for restoration work.

3.05 MATERIALS TO BE REMOVED

A. Remove existing nonhistoric elements as indicated and as required to allow direct access to period construction elements indicated to be restored or salvaged for reuse.

B. Protect existing historic elements.
   1. Prevent movement of structure; provide temporary, removable shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly, minimizing overcutting.

3.06 MATERIALS TO BE RECYCLED

A. Recycle removed nonhistoric materials to the maximum extent possible. Remove recyclable materials by hand wherever possible.

B. Recycle items indicated on drawings.

3.07 CLEANING

A. Upon completion of work, clean dust, dirt, and debris caused by salvage and demolition operations from portions of existing structure to remain and adjacent areas. Remove and transport debris and rubbish in a manner that prevents spillage on streets or adjacent areas. Obey local regulations regarding hauling and disposal.

END OF SECTION 02 03 42

SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 00 31 00 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.

B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.

C. Section 01 10 00 - Summary: Sequencing and staging requirements.

D. Section 01 10 00 - Summary: Description of items to be removed by Owner.

E. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

F. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

G. Section 02 03 42 - Removal and Salvage of Period Construction Materials.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Building Plan: Showing:
   1. Areas for temporary construction and field offices.
   2. Areas for temporary and permanent placement of removed materials.

C. Demolition Plan: Submit demolition plan.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

A. Remove portions of existing buildings as indicated on drawings.

B. Remove other items indicated, for salvage or relocation.

C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.

4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
6. Do not close or obstruct roadways or sidewalks without permit.
7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

F. Utilize temporary partitions to separate occupied areas from dust, noise and other demolition activities.

G. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
1. Lead-Based Paint: May remain in-place and be re-coated, subject to compliance with notification provisions cited.
2. Lead-Based Paint: Notify of the existence of lead paint prior the commencement of demolition activities per 29 CFR 1926.62 of the OSHA Lead Standard for the Construction Industry.
3. Lead-Based Paint: For any removed paint, conduct waste stream characterization in accordance with Louisiana Department of Environmental Quality (LDEQ) Hazardous Waster regulations, LAC 33.V.1, Chapter 11 for disposal as construction debris.
4. Asbestos Containing Materials (ACM): File LDEQ form "Notification of Demolition and Renovation Form" (AAC-2) at lest 10 working days prior to the scheduled date of removal. For the purposes of the application, the building is not "State Owned."
5. Asbestos Containing Materials (ACM): Comply with OSHA 1926.1101 and LDEQ 5151. Properly bag and dispose of non-friable asbestos panels at recognized asbestos landfill with proper authorization.
6. Asbestos Containing Materials (ACM): Non-friable asbestos panels that are rendered friable through actions of the contractor shall be abated by a licensed asbestos abatement professional at no additional cost to Owner.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 50 00 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
   1. Schedule demolition of glazing no more than 30 days prior to the receipt of new aluminum and glass curtain wall materials.
   2. Roof is to removed at the same time as re-roofing, so that roof remains water-tight. Refer to Section 07 01 50.19.

D. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 02 41 00

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Floors and slabs on grade, patching existing.

B. Concrete reinforcement.

C. Joint devices associated with concrete work.

D. Concrete curing.

1.02 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.

C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

E. ACI PRC-308 - Guide to External Curing of Concrete; 2016.

F. ACI SPEC-301 - Specifications for Concrete Construction; 2020.

G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

I. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.

J. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

K. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

L. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

M. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2015.

N. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2021.

O. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.

P. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.

Q. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.
   1. Indicate proposed mix design complies with requirements of ACI CODE-318, Chapter 5 - Concrete Quality, Mixing and Placing.

D. Samples: Submit samples of underslab vapor retarder to be used.

E. Test Reports: Submit report for each test or series of tests specified.

1.04 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.

PART 2 PRODUCTS

2.01 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished, unless otherwise indicated.

B. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type I - Normal Portland type.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

C. Fly Ash: ASTM C618, Class C or F.

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

2.03 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

2.04 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
   1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single-ply polyethylene is prohibited.
   2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.

2.05 BONDING AND JOINTING PRODUCTS

A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.

B. Epoxy Bonding System:
   1. Complying with ASTM C881/C881M and of Type required for specific application.

2.06 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.

B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
   1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.

D. Normal Weight Concrete:
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch (27.6 MPa).
   2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
   3. Water-Cement Ratio: Maximum 40 percent by weight.
   4. Maximum Aggregate Size: 5/8 inch (16 mm).

2.07 MIXING

A. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
   1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
   2. Use latex bonding agent only for non-load-bearing applications.

B. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI SPEC-301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI PRC-304.

B. Notify Architect not less than 24 hours prior to commencement of placement operations.

C. Ensure reinforcement will not be disturbed during concrete placement.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. Maximum Variation of Surface Flatness:
   1. Exposed Concrete Floors: 1/4 inch (6 mm) in 10 feet (3 m).
   2. Under Seamless Resilient Flooring: 1/4 inch (6 mm) in 10 feet (3 m).
   3. Under Carpeting: 1/4 inch (6 mm) in 10 feet (3 m).

B. Correct the slab surface if tolerances are less than specified.

C. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE FINISHING

A. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
   1. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
   2. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Surfaces Not in Contact with Forms:
   1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
   2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
   3. Final Curing: Begin after initial curing but before surface is dry.

3.08 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.

E. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION 03 30 00

SECTION 04 03 00
CONSERVATION TREATMENT FOR PERIOD MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cleaning of existing coated masonry surfaces. Non-coated historic stone masonry to remain and be cleaned only to the extent required under Final Cleaning.

B. Replacement of existing stone masonry units, where indicated on drawings.

C. Repair of damaged existing masonry, where indicated on drawings.

D. Raking and repointing of existing mortar joints, only at replaced units.

E. Mortaring of new stone masonry joints.

1.02 RELATED REQUIREMENTS

A. Section 01 35 91 - Period Treatment Procedures for general historic preservation project requirements.

B. Section 04 43 13 - Stone Masonry Veneer.

1.03 ABBREVIATIONS AND ACRONYMS

A. NPS: National Park Service, part of U.S. Department of the Interior.

B. TPS: Technical Preservation Services, part of National Park Service.

1.04 DEFINITIONS

A. Aggregates: Sand component of mortar.

B. Dutchman: Repair method to partially remove deteriorated portion of stone and replace with salvaged or new stone.

C. In situ: Masonry units and mortar remain in place and are restored without removal.

D. New Elements: New, nonhistoric materials added to masonry structures to aid in resistance to structural loads or water infiltration.

E. Patching: Use of substitute repair materials to treat damaged or deteriorated masonry units in situ.

F. Repointing: Removal of existing mortar joints to specified depth and replacement with mortar matching color, texture, and performance of original mortar, and with water vapor transmission, bond, hardness, and flexibility compatible with original mortar, tested in accordance with ASTM C1713.

G. Retooling: Chisel is used to recreate surrounding stone texture finish.

H. Surface Treatment: Application of traditional materials or contemporary chemical products to surface of masonry to provide protection to the masonry and mortar or reduce water infiltration.

1.05 REFERENCE STANDARDS

A. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile; 2013 (Reapproved 2017).

B. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.

C. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2025.

D. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

E. ASTM C1713 - Standard Specification for Mortars for the Repair of Historic Masonry; 2023.

1.06 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.
   1. Require attendance of parties directly affecting work of this section.
   2. Review installation conditions, procedures, and coordination with related work.

B. Scheduling of Period Treatments: Perform cleaning and washing of masonry between the hours of 7 a.m. and 7 p.m. only.

1.07 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on cleaning compounds.

C. Shop Drawings: Indicate setting details of stone. Detail shoring.

D. Samples: Submit four samples of stone units to show matching color, texture, and extremes of color range.

E. Restorer's qualification statement.

1.08 MOCK-UPS

A. Restore and repoint existing masonry wall defined as follows and on drawings. Include mortar, accessories, and wall openings.
   1. Repointing Mortar Joints:
      a. Minimum Dimensions: 12 feet (4 m) long; 2/3 of length for horizontal joints and 1/3 of length for vertical joints.
   2. Retooling Stone Masonry In-Situ: Demonstrate retooling of three deteriorated stone faces in-situ in historic profile textures indicated on drawings.
   3. Stone Masonry Column Slab and Floor Tile Removal and Replacement: Remove masonry and replace to match existing dimensions and texture, unless indicated otherwise. Size shall represent typical conditions.
      a. Set one masonry unit in same location; match joint width and bond pattern, using mortar specified.
      b. Dry set one unit in opening, set on wood shims for evaluation and approval of preparation conditions.
      c. Confirm with Architect that replacement masonry units meet specified requirements, and that quantity required for the work has been identified.
   4. Application of Repair Materials:
      a. Patching: Apply repair material on minimum two masonry units of type scheduled for repair.
         1) Demonstrate removal of previous patching and application of new patching on one masonry unit.
         2) Remove metal anchors at two locations and fill in the holes with repair material on minimum one masonry unit.
   5. Surface Treatments: Install minimum 16 sq ft (1.5 sq m) mock-up for each type of surface treatment on each type of substrate to be treated. For water repellents and consolidants, demonstrate the equipment and installation procedure. Allow 48 hours for limewash applications to dry to their final color and appearance.
   6. New Masonry Elements: Install one of each type of new component, demonstrating final installation method and finished appearance.

B. Clean a 10-foot (3 m) by 10-foot (3 m) panel of wall of each type of period masonry.

C. Locate mock-up areas where directed.

D. Approved restoration mock-up areas, including results of procedures employed, will remain and become the quality standard for work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver masonry neatly stacked and tied on pallets. Store clear of ground with adequate waterproof covering.

1.10 FIELD CONDITIONS

A. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

B. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

A. Cleaning Agent: Detergent type.

2.02 MORTAR MATERIALS

A. Hydraulic Hydrated Lime:

B. Hydrated Lime: ASTM C207, Type S.

C. Water: Clean and free of oils, acids, alkalies, salts, organic materials, or other substances that are deleterious to mortar or metal it comes in contact with.

D. Sand: ASTM C144.

E. Mortar Mixing:
   1. General Requirements:
      a. Do not use modern additives unless permitted in writing by Architect.
      b. Match the historic mortar in color, texture, and tooling.
   2. Mortar for Stone:
      a. Use lime and sand mortars with compressive strength approximately 1/3 of compressive or crushing strength of stone units.

2.03 MASONRY UNIT MATERIALS

A. Replacement Stone: See Section 04 43 13.

B. Replacement Clay Tile Units:
   1. Structural Clay Nonloadbearing Tile: ASTM C56, Grade NB; plaster-base finish.
   2. Color and texture: as selected from manufacturer's full range.
   3. Nominal size: match existing.
   4. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

2.04 STONE PATCHING MATERIALS

A. Fine-Grained Stone: Products and materials designed for mixing with stone aggregate for patching fine-grained natural stone, including granite, marble, and honed-finish limestone.

2.05 BONDING ADHESIVES

A. General: Products designed specifically for repairing and bonding masonry.

B. Cementitious Anchor Grout: Vapor permeable, hydraulic, cement-based grout; no latex, acrylic, or epoxy constituents.
   1. Application: For bonding anchors to masonry.
   2. Cured Properties:
      a. Compressive Strength: 4,000 psi (27.58 MPa) to 5,000 psi (34.47 MPa) minimum at 7 days, tested in accordance with ASTM C109/C109M.

2.06 PAINT REMOVERS

A. Manufacturers:
   1. American Building Restoration Products, Inc: www.abrp.com/#sle.
   2. Dumond Chemicals, Inc: www.dumondchemicals.com/#sle.
   3. PROSOCO, Inc: www.prosoco.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Water-Based: Formulated without methylene chloride or methanol and used for removal of multiple coats of oil-based, water-based, acrylic-based, epoxy-based, urethane-based, elastomeric, and lead-based paints.
   1. Formulation: Thixotropic paste or gel.
   2. Acidic Type: 2.1 pH.
   3. Surface Neutralization After Use: Not required.
   4. Restrictions: Not intended by the manufacturer for use on furniture, polished surfaces, or for removal of cementitious coatings.

2.07 ACCESSORY MATERIALS

A. Molds for Replication of Masonry Elements: Provide accurate molds of existing elements in situ, for replication by casting.

B. Colorants, When Required for Exact Color Match: Nonfading, mineral oxide masonry pigment as approved by the Architect.

PART 3 EXECUTION

3.01 PERIOD TREATMENT, GENERAL

A. See Section 01 35 91 for special procedure requirements related to elements and features of historical significance and value.

3.02 EXAMINATION

A. Verify that surfaces to be cleaned and restored are ready for work of this section.

3.03 EVALUATION AND ASSESSMENT

A. Begin masonry work after evaluation and analysis of areas to be repaired are completed including, but not limited to, sampling and testing of the existing mortar to determine its composition and qualities.

B. Do not start repairs until conditions causing masonry deterioration have been identified.

C. Analyze composition of existing historic bedding mortar to provide basis for matching with new mortar.

3.04 PREPARATION

A. Protect other elements from damage that may result from restoration procedures.

B. Carefully remove and store identified items located in areas to be restored including, but not limited to, fixtures, fittings, finish hardware, and accessories; reinstall upon completion of restoration work.

C. Protect nonrestoration areas from restoration areas to prevent damage.

D. Mask or cover adjacent surfaces and permanent equipment. Secure coverings without using nails and without tape that leaves residue. Do not use impervious sheeting which produces condensation.
   1. Use materials that will withstand cleaning and restoration procedures.

E. When using liquid cleaning methods, provide drainage devices to prevent runoff over adjacent surfaces, unless those surfaces are impervious to damage from runoff.

F. Do not allow cleaning runoff to drain into sanitary or storm sewers.

3.05 PAINT REMOVAL

A. Remove existing coatings to bare substrate or first sound paint layer as indicated.

B. Removal with Chemical Products: Use products in accordance with manufacturer's instructions.
   1. Vertical Surfaces: Work from the bottom up; apply undiluted removal product to dry surfaces in thickness recommended by manufacturer.
   2. Allow product to dwell on existing surface as recommended by manufacturer or until existing coating shows signs of dissolving. Periodically agitate applied remover product with a stiff bristle brush to improve penetration into existing coating.
   3. Interior Elements: Unless otherwise indicated or recommended by paint remover manufacturer, use the following procedures:
      a. Using low-pressure tank or pump-up sprayer, mist treated surface with clean water to emulsify old sealer and dilute the remover.
      b. Floors: Scrub surfaces until remover and coating residue no longer adhere to substrate. Use power scrubber or buffer with abrasive, nonmetallic scrubbing pad. Add clean water as necessary to aid scrubbing. Dispose of remover and coating residues.
      c. Walls: Scrub surfaces with stiff-bristle brush until remover and existing coatings residue no longer adhere to substrate. Add clean water as necessary to aid scrubbing.
      d. Use towels, mops, or wet vacuums to collect liquid residue. Use caution when vacuuming solvent-containing residue.
   4. Neutralize pH of stripped surfaces after using acidic-based or alkaline-based removers as recommended by remover manufacturer.
      a. Brush apply prepared neutralizer to treated surfaces in gentle scrubbing manner. Allow neutralizer to remain on surface for time period recommended by manufacturer.
      b. Rinse treated area thoroughly, and remove all traces of paste residue and solubilized coating.

c. Test surfaces to ensure neutralization has been achieved using pH papers, pH pens, or pH indicator solutions. Repeat applications of neutralizer until surfaces test between pH 5.0 and pH 9.0.
d. Allow neutralized surface to dry thoroughly. Before applying new surface coatings, retest surfaces to confirm adequate neutralization and prevent surface discoloration or failure of new coatings.

5. Ensure that chemicals and coating residue are removed from substrate.

C. Leave surfaces in clean, residue-free condition, ready for subsequent restoration procedures.

3.06 INSTALLATION

A. Do not mix or apply materials when the ambient temperature or humidity are outside of range recommended by their manufacturers.

B. Schedule conservation treatments to be carried out during appropriate environmental conditions to avoid weather-related failures.

3.07 REPAIR

A. Stone Masonry Unit Patching: Patch units indicated on drawings.
1. Patching Compound:
a. Mask off areas to be kept free of compound.
b. Apply with trowel or similar implement into and over area to be repaired.

3.08 MASONRY UNIT REPLACEMENT

A. Cut out damaged and deteriorated masonry to prevent damage to adjacent materials.

B. Support structure as necessary prior to cutting out units.

C. Cut away loose or unsound, adjoining masonry as directed.

D. Build in new units for new work as specified in other sections.

E. Mortar Mix: Color and proportion to match existing.

F. Ensure that anchors are correctly located and built in.

G. Install built-in masonry work to match and align with existing, with joints and coursing true and level, faces plumb and in line. Build-in all openings, accessories, and fittings.

3.09 REPOINTING

A. Perform repointing prior to cleaning masonry surfaces.

B. Cut out loose or disintegrated mortar in joints to minimum 1/2-inch (6 mm) depth or until sound mortar is reached.

C. Exercise appropriate caution to prevent damage to existing masonry.

D. When cutting is complete, remove dust and loose material with air jet.

E. Premoisten joints and apply pointing mortar. Pack tightly in maximum 1/4-inch (6 mm) layers. Form a smooth, compact concave joint to match existing.

F. Moist cure for 72 hours.

3.10 RESTORATION CLEANING

A. Preclean surfaces and remove large particles with wood scrapers or nonferrous wire brush.

B. Perform cleaning and rinsing of exterior masonry only during daylight hours.

C. Restoration Cleaners:
1. Do not use acidic chemical cleaners on limestone, marble, concrete, or other calcareous masonry materials.
2. Apply restoration cleaner on masonry using brush or roller in accordance with manufacturer's instructions.
3. Provide a second application if required to match mock-up area.
4. Allow sufficient time, as recommended by manufacturer, for solution to remain on masonry.

D. Washing or Rinsing Vertical Surfaces:

1. Rinse from the bottom up with potable water applied at 600 psi (4140 kPa) and at a rate of 6 gpm (24 L/min) through a 15 to 45 degree fan spray tip.
    a. Use adjustable equipment capable of reducing water pressure and flow rate as needed for sensitive surfaces.
    b. Rinse with water and pressure sufficient to flush restoration cleaner and dissolved soiling from the masonry surface and surface pores without damaging masonry. Do not leave cleaning procedure residues on masonry.

E. Washing or Rinsing Horizontal Surfaces:
1. Wash surface thoroughly with fresh water using a sponge or cloth. Let surfaces dry thoroughly.

3.11 CLEANING

A. Remove stains, efflorescence, or other excess resulting from the work of this section. Do without delay to avoid penetration and setting.

B. Remove excess mortar, smears, and droppings as work proceeds and upon completion.

C. Clean surrounding surfaces.

END OF SECTION 04 03 00

SECTION 04 26 16
ADHERED MASONRY VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Thin Brick, Owner-Provided.

B. Mortar.

C. Adhesives.

D. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Wall tile for veneer applications.

1.03 REFERENCE STANDARDS

A. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2018.

C. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2025a.

D. ASTM C1088 - Standard Specification for Thin Veneer Brick Units Made from Clay or Shale; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, mortar, grout, and adhesive.

C. Samples: Submit four samples of masonry units to illustrate color, texture, and extremes of color range.

D. Manufacturer's Certificate: Certify masonry units, adhesives, mortar, and grout meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.07 MOCK-UPS

A. Construct a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, grout, adhesives, accessories, substrate, and representative wall openings in mock-up.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

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

1.09 FIELD CONDITIONS

A. Do not install adhesives in an unventilated environment.

B. Maintain materials and surrounding air temperature to minimum 40 degrees F (5 degrees C) prior to, during, and 48 hours after completion of masonry work.

C. Maintain materials and surrounding air temperature to maximum 90 degrees F (32 degrees C) prior to, during, and 48 hours after completion of masonry work.

PART 2 PRODUCTS

2.01 THIN BRICK

A. Thin Brick, Owner-provided, for reference only: ASTM C1088.
   1. Type: TBX.
   2. Size: Manufacturer's standard Modular.
   3. Thickness: 1/2 inch (12.7 mm).
   4. Tolerances: 1/16 inch (1.6 mm).
   5. Protective Coating: None.
   6. Brickwebb: masonry units ahdered in a mosiac:
      a. Unit size: 7-5/8 inches x 2-1/4 inches.

2.02 ADHESIVE MATERIALS

A. Thin-Set Mortar: As recommended by manufacturer for high-temperature application.

2.03 MORTAR MATERIALS

A. Masonry Cement: ASTM C199: Refractory Mortars.
   1. Calcium Aluminate Cement

B. Fire Clay: ASTM F1097.

C. Masonry Sand Mix.

D. Water: Clean and potable.

E. Mixture Ratio:
   1. 10 Parts Sand
   2. 3 parts cement
   3. 1.5 parts fire clay
   4. Water to form a workable mix

2.04 MORTAR MIXES

A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.

2.05 ACCESSORIES

A. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field conditions meet masonry manufacturer's requirements to receive masonry veneer.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify built-in items are in required location and ready for installation of masonry veneer.

3.02 INSTALLATION

A. Thin Brick:

B. Thin Brick Panel System: Install according to manufacturer's written instructions.

3.03 COURSING

A. Establish lines, levels, and coursing as indicated on drawings. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:
   1. Bond: Running.
   2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).
   3. Mortar Joints: Raked.

3.04 PLACING AND BONDING

A. Remove excess mortar as work progresses.

B. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove and replace.

C. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

3.05 TOLERANCES

A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch (1.6 mm).

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m) and 1/2 inch in 20 feet (13 mm in 6 m) or more.

C. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; 1/2 inch (13 mm) in two stories or more.

D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm in 1 m) and 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 30 feet (13 mm in 9 m).

E. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft (3 mm/m).

3.06 CUTTING AND FITTING

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

3.07 CLEANING

A. Remove excess mortar and mortar smears as work progresses.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.08 PROTECTION

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

END OF SECTION 04 26 16

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SECTION 04 43 16
STONE FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated crystaline limestone items (Tennessee Marble).

B. Fabricated dolomitic limestone items (Jura Beige Limestone).

C. Metal anchors and supports.

D. Pointing interior joints.

1.02 RELATED REQUIREMENTS

A. Section 04 03 00 - Conservation Treatment for Period Masonry.

B. Section 07 92 00 - Joint Sealants: Sealing perimeter and expansion joints in interior stone work.

C. Section 12 36 00-Countertops: Countertops made of same stone material.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

C. ASTM C119 - Standard Terminology Relating to Dimension Stone; 2022.

D. ASTM C568/C568M - Standard Specification for Limestone Dimension Stone; 2022.

E. ASTM C1528/C1528M - Standard Guide for Selection of Dimension Stone; 2020.

F. ILI (HB) - Indiana Limestone Handbook; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on each stone type, mortar products, and sealant products.

C. Shop Drawings: Indicate fabrication details, layout, pertinent dimensions, anchorages, and jointing methods.
   1. Include large scale details of decorative surfaces and inscriptions.

D. Samples: Submit three stone samples, indicating color range and texture, markings, surface finish.

E. Samples: Submit mortar color samples.

F. Installation Instructions: Submit stone fabricator's installation instructions and field erection or setting drawings; indicate stone identifying marks and locations on setting drawings.

G. Stone fabricator's qualification statement.

H. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Limestone: Perform work in accordance with ILI (HB).

B. Stone Fabricator: Company specializing in fabricating stone with minimum ten years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. See Section 04 03 00 - Conservation Treatment for Period Masonry for mock-up components.

C. Locate where directed.

D. Mock-up may remain as part of the work.

PART 2 PRODUCTS

2.01 FABRICATED ITEMS

A. Column Facings : Dolomitic Limestone.
   1. Size, Shape, and Configuration: As indicated on drawings.

B. Pilasters: Dolomitic Limestone.
   1. Size, Shape, and Configuration: As indicated on drawings.

C. Stair Treads: Crystaline Limestone.
   1. Size, Shape, and Configuration: As indicated on drawings.

D. Replacement Wall Panels: Crystaline Limestone.
   1. Size, Shape, and COnfiguration: As indicated on drawings.

2.02 STONE

A. Dolomitic Limestone: Jura Beige variety; complying with ASTM C568/C568M Classification II - Medium Density.
   1. Color: Buff.
   2. Surface Finish: Honed; as described in ASTM C119 and ASTM C1528/C1528M.
   3. Acceptable Producers:
      a. KLZ Stone Supply, Inc; www.klzstone.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Crystaline Limestone: Tennessee Marble variety; complying with ASTM C568/C568M Classification II - Medium Density.
   1. Color: Pink, Buff and Gray to match existing.
   2. Surface Finish: Honed; as described in ASTM C119 and ASTM C1528/C1528M.
   3. Acceptable Producers:
      a. Tennessee Marble Company: www.tnmarble.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MORTAR

A. Mortar: See Section 04 03 00.

2.04 ANCHORS AND ACCESSORIES

A. Anchors and Other Components in Contact with Stone: Copper wire, minimum 8 gauge.
   1. Sizes and configurations: As required for vertical and horizontal support of stone and applicable loads.

B. Support Components not in Contact with Stone: Steel, ASTM A36/A36M, galvanized after fabrication to ASTM A123/A123M 1.25 oz/sq ft (Steel, ASTM A36/A36M, galvanized after fabrication to ASTM A123/A123M 380 g/sq m).

C. Setting Buttons and Shims: Plastic type.

D. Bond Breaker: 10 mil (0.25 mm) thick plastic sheet.

2.05 STONE FABRICATION

A. Fabricate stone elements in sizes and shapes as necessary and in compliance with requirements indicated on drawings and in specifications.

B. Cut and drill depressed areas and holes in stones for anchors, fasteners, supports, and lifting devices as indicated or as necessary to set stonework securely in place; shape beds to fit supports. Allow room for expansion of the anchoring devices where necessary.

C. Fabricate profiled stone work, including washes and drips, to produce stone shapes with uniform profile throughout their entire length and with precisely formed arises slightly eased to prevent snipping, and matched at joints between units.

D. Carve and cut decorative surfaces and inscriptions to conform with drawings or models approved by Architect, and employ skilled stone carvers experienced in successful performance of work similar to that being specified.

E. Finish exposed faces and edges of stones in compliance with indicated requirements for finish under each type and application of stone required and to match approved samples and mock-ups.

F. Cut stones to fabricate pieces of thickness, size, and shape as indicated or required for this work within fabrication tolerances recommended by ILI (HB).

G. Fabricate units for uniform coloration between adjacent units and over the full area of the installation.

H. Where corner detail is not indicated, form external corners to quirk joint profile.

I. Fabricate for 3/8 inch (10 mm) beds and joints.

J. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that support work and site conditions are ready to receive work of this section.

B. Verify that built-in items are properly located and sized.

3.02 PREPARATION

A. Clean stone prior to erection. Do not use wire brushes or implements that will mark or damage exposed surfaces.

3.03 INSTALLATION

A. Erect stone in accordance with stone supplier's instructions and erection drawings.

B. Set stone with a consistent joint width of 1/4 inch (6 mm).

C. Joints in Interior Work: Leave perimeter joints and expansion joints open for sealant; fill other joints with pointing mortar; pack and work into voids; tool surface to concave joint.

3.04 TOLERANCES

A. Positioning of Elements: Maximum 1/4 inch (6 mm) from true position.

B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch in 50 feet (13 mm in 15 m).

C. Maximum Variation Between Face Plane of Adjacent Panels: 1/16 inch (1.5 mm).

D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story noncumulative; 1/2 inch (13 mm) in any two stories.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm in 1 m); 1/4 inch in 10 feet (6 mm in 3 m); 1/2 inch (13 mm) maximum.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet (3 mm in 1 m).

3.05 CUTTING AND FITTING

A. Obtain approval prior to cutting or fitting any item not so indicated on drawings.

B. Do not impair appearance or strength of stone work by cutting.

3.06 CLEANING

A. Remove excess joint material upon completion of work.

B. Clean soiled surfaces with cleaning solution.

C. Use nonmetallic tools in cleaning operations.

END OF SECTION 04 43 16

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SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed steel joist framing and bridging. Structural Design has been performed by design team.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking and miscellaneous framing.

B. Section 09 21 16 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2019.

E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

F. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
   1. CEMCO: www.cemcosteel.com/#sle.
   2. ClarkDietrich: www.clarkdietrich.com/#sle.
   3. Steel Construction Systems: www.steelconsystems.com/#sle.
   4. SuperStud Building Products: www.https://www.buysuperstud.com/.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Framing Connectors and Accessories:
   1. Same manufacturer as metal framing.
   2. Simpson Strong Tie: www.strongtie.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

2.03 FRAMING MATERIALS

A. Joists: Fabricated from ASTM A653/A653M steel sheet, with G90/Z275 hot dipped galvanized coating.
   1. Gauge and Depth: As indicated on drawings.

B. Framing Connectors: Factory-made, formed steel sheet.

1. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
2. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections at the following locations:
   a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
   b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1/2 inch (13 mm).
   c. Products:
      1) ClarkDietrich; FastClip Slide Clip FCSC: www.clarkdietrich.com/#sle.
      2) ClarkDietrick; MaxTrak: www.clarkdietrich.com/#sle
      3) Substitutions: See Section 01 60 00 - Product Requirements.
3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.

B. Anchorage Devices: Powder actuated.

C. Welding: Comply with AWS D1.1/D1.1M.

2.05 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.

B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF JOISTS

A. Install framing components in accordance with manufacturer's instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 16 inches (400 mm) on center; not more than 2 inches (50 mm) from abutting walls, and connect joists to supports using fastener method.

D. Set floor joists parallel and level, with lateral bracing and bridging.

E. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION 05 40 00

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

B. Steel framing and supports for countertops and bartops.

C. Aluminum frame supports for exterior mechanical equipment.

D. Stainless steel wall panels not provided by kitchen hood manufacturer.

1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting: Paint finish.

B. Section 09 91 23 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

E. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2020a.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

L. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

N. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata.

O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

P. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

Q. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Stainless Steel, General: ASTM A666, Type 304.

F. Stainless Steel Finish: No. 4 Bright Polished finish.

G. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.

H. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Bolts, Nuts, and Washers: Stainless steel.

C. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Countertop Supports: Fabricate from steel angles complying with the referenced standards; prime paint finish.

B. Bartop Supports: Fabricate from from steel angle and steel T shapes as indicated in drawings.

C. Partial-height Partition Supports: Steel tube shapes with 3/8 inch steel plate base plates secured with minimum two bolts. Base plate shall not exceed depth of partition; prime paint finish.

D. Supports for Exterior Mechanical Equipment: Aluminum tube shapes with welded connections and bolted aluminum grating surfacing, bolted to existing exterior masonry wall with epoxy anchors.

E. Stainless Steel Wall Panels: 20 gauge sheet steel, fabricated into sizes as indicated on drawings. Provide perimeter and joint trim matching panels.

2.05 FINISHES - STEEL

A. Prime paint steel items.
   1. Exceptions: Galvanize items to be embedded in concrete, items to be embedded in masonry, items specified for galvanized finish, and all exterior items.
   2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating. (Provide minimum 530 g/sq m galvanized coating.)

F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

G. Stainless steel sheet: ASTM A240A240M, chromium and chromium-nickel plate.

2.06 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I natural anodized.

B. Interior Aluminum Surfaces: Class I natural anodized.

C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch (3 mm) maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch (1.5 mm).

C. Maximum Misalignment of Adjacent Members: 1/16 inch (1.5 mm).

D. Maximum Bow: 1/8 inch (3 mm) in 48 inches (1.2 m).

E. Maximum Deviation From Plane: 1/16 inch (1.5 mm) in 48 inches (1.2 m).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Perform field welding in accordance with AWS D1.1/D1.1M.

D. Obtain approval prior to site cutting or making adjustments not scheduled.

E. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

C. Maximum Out-of-Position: 1/4 inch (6 mm).

END OF SECTION 05 50 00

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonstructural dimension lumber framing.

B. Rough opening framing for doors, windows, and roof openings.

C. Fire retardant treated wood materials.

D. Communications and electrical room mounting boards.

E. Concealed wood blocking, nailers, and supports.

1.02 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

C. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.

D. PS 1 - Structural Plywood; 2023.

E. PS 20 - American Softwood Lumber Standard; 2020.

F. SPIB (GR) - Standard Grading Rules; 2021.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.05 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Southern Pine, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Southern Pine Inspection Bureau, Inc; SPIB (GR).

B. Sizes: Nominal sizes as indicated on drawings, Rough (unsurfaced).

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

A. Wall Sheathing: Plywood, PS 1, Grade C-D, Exposure I.

B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2.05 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items: dimensioned lumber used as framing and construction panels. Dimensioned lumber used as blocking does not require treatment.
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.02 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.03 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.

B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
   1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
   2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
   3. Install adjacent boards without gaps.

3.04 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.05 SCHEDULES

A. Fire-Retardant Treatment Locations
   1. Construction panels concealed behind other finishes
   2. Dimensioned lumber used as framing within walls.

B. All other rough carpentry locations, including, but not limited to, concealed blocking for such as handrails, millwork, cabinets and window and door frames, shall not require fire-retardant treatment.

END OF SECTION 06 10 00

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

B. Wood wall base.

C. Plywood panels and wood base at banquette millwork

D. Wood door frames, glazed frames.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 42 00 - Wood Paneling: Shop fabricated custom paneling, including paneling at the top and sides of banquettes.

C. Section 09 91 13 - Exterior Painting: Painting of finish carpentry items.

D. Section 09 91 23 - Interior Painting: Painting of finish carpentry items.

E. Section 09 93 00 - Staining and Transparent Finishing: Staining and transparent finishing of finish carpentry items.

1.03 REFERENCE STANDARDS

A. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.

B. NHLA G-101 - Rules for the Measurement and Inspection of Hardwood and Cypress; 2023.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Samples: Submit two samples of wood trim.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.

B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.

C. Protect from moisture damage.

D. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Exterior Woodwork Items:
   1. Window Casings and Moldings: Softwood; prepare for paint finish.

C. Interior Woodwork Items:
   1. Wall Base and Miscellaneous Trim:
      a. Hardwood or softwood lumber, sizes indicated in drawings, used as wall base and trim.
      b. Thickness: 3/4 inch.
   2. Door, Glazed Light, and Pocket Door Frames: Poplar or birch; prepare for paint finish.
   3. Stairs, Balustrades, and Handrails: Clear oak; prepare for stained finish.

2.02 LUMBER MATERIALS

A. Softwood Lumber: Pine or poplar species, plain sawn, maximum moisture content of 6 percent, of quality suitable for painted finish.
   1. Grading: In accordance with rules certified by ALSC; www.alsc.org.

B. Hardwood Lumber: Walnut species, quarter sawn, maximum moisture content of 6 percent ; with vertical grain , of quality suitable for transparent finish.
   1. Grading: In accordance with NHLA G-101 Grading Rules; www.nhla.org.

C. Exterior Hardwood Lumber: Red Grandis species, plain sawn, maximum moisture content of 6 percent of quality suitable for painted finish.
   1. Grading: In accordance with NHLA G-101 Grading Rules; www.nhla.org.

2.03 SHEET MATERIALS

A. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

B. Lumber for Shimming and Blocking: Softwood lumber of southern pine species.

2.06 SITE FINISHING MATERIALS

A. Finishing: Field finished as specified in Section 09 93 00.

2.07 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (0.79 mm). Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.79 mm).

3.04 SCHEDULE

A. WDB-01: Softwood wall base for opaque finish as indicated on drawings.

B. WDB-02: Softwood wall base for opaque finish as indicated on drawings.

C. Wood base at banquetes and restaurant millwork: Hardwood wall base for transparent finish as indicated on drawings.

D. WDF-01: Not used.

E. WDM-01: Hardwood molding for transparent finish as indicated on drawings

F. WDP-01: See Section 06 42 00.

G. WDP-02: See Section 06 42 00.

H. WDP-03: See Section 06 42 00

I. Exterior Wood Trim: Exterior hardwood for opaque finish as indicated on darwings.

END OF SECTION 06 20 00

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SECTION 06 42 00
WOOD PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Custom wood veneer and solid wood paneling for banquettes and other locations as indicated on drawings.

B. Shop finishing.

1.02 RELATED REQUIREMENTS

A. Section 09 93 00 - Staining and Transparent Finishing: Field finishing of adjacent finish carpentry.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).

C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

C. Samples: Submit two samples of finished plywood for transparent finish, illustrating wood grain and specified finish.

D. Samples: Submit two samples of wood trim.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect work from moisture damage.

B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

PART 2 PRODUCTS

2.01 PANELING

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless otherwise indicated.

B. Flat Paneling:
   1. Species: Walnut for transparent finishing, as indicated.
   2. Panel Construction: 3/4 inch (19 mm) plywood panels with applied veneer.
   3. Cut: Plain-sawn.
   4. Panels: Veneer of full width and balanced sequence matched.
      a. Panels More Than One Leaf High: Architectural end matching.
      b. Each Panel Within Single Area: Premanufactured sets selectively reduced in width, and doors and other components.
   5. Visible Edges and Reveals: Match faces.
   6. Outside Corners: Mitered and splined.
   7. Finish: As indicated in Schedule.

C. Reeded Paneling
   1. Species: Walnut for transparent finishing.
   2. Panel Construction: 1/2 inch (12.7 mm) solid wood panels.
      a. Provide 1/4 inch (6.4 mm) wood panels at curved locations.

3. Cut: Flat-sawn
4. Reeding: 3/8 inch (10mm).
5. Visible Edged and Reveals: Finished to match faces.
6. Outside Corners: Butt-jointed with primary (longer) face extending into the joint.
7. Finish: As indicated in Schedule.

2.02 WOOD-BASED MATERIALS - GENERAL

A. Hardwood Plywood: HPVA HP-1 Grade A; veneer core, type of glue recommended for application; of grain quality suitable for transparent finish.
   1. Thickness: 3/4 inches (19 mm)

B. Medium Density Fiberboard (MDF): Engineered wood panel with a smooth, unblemished surface and homogeneous core composed of wood fibers from softwoods, containing no .
   1. Thickness: 3/4" inches (19 mm)

C. Lumber: Maximum moisture content of 6 percent; with vertical grain , of quality suitable for transparent finish.

2.03 ADHESIVES AND FASTENERS

A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.

B. Fasteners: Of size and type to suit application.

2.04 FABRICATION

A. Prepare panels for delivery to site, permitting passage through building openings.

B. Finish exposed edges of panels as specified by grade requirements.

C. Fabricate metal veneer panels with a lip at the edges to allow for concealed hanging hardware.

2.05 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent for Flat Panels:
      a. System - 8, Acrylic Cross Linking, Water-based .
      b. Stain: As selected by Architect.
      c. Sheen: Satin.
      d. Products:
         1) Sherwin-Williams; Sher-Wood Kem-Aqua Plus Clear: www.sherwin-williams.com/#sle.
         2) Substitutions: Section 01 60 00 - Product Requirements.
   2. Transparent for Reeded Panels:
      a. System - 2, Lacquer, Precatalyzed.
      b. Stain: As selected by Architect.
      c. Sheen: Flat.
      d. Products:
         1) Sherwin-Williams; Sher-Wood Hi-Bild Precat Lacquer: www.sherwin-williams.com/#sle.
         2) Substitutions: Section 01 60 00 - Product Requirements.

E. Wood Sealer: Factory-applied, water-based polymer, water-repellent sealer that reacts chemically with untreated, natural wood surfaces.

F. Prime paint surfaces that will be in contact with cementitious materials.

G. Back prime woodwork items to be field finished, prior to installation.

2.06 ACCESSORIES

A. Lumber for Shimming, Blocking: Softwood lumber of southern pine species.

B. Primer: Alkyd primer sealer type.

C. Wood Filler: Tinted to match surface finish color.

D. Metal Veneer Panel hanger clips: Extruded aluminum Z Clip concealed hanging system attached to back of panels.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify adequacy of backing and support framing.

C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Do not begin installation until wood materials have been fully acclimated to interior conditions.

C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.

D. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.

E. Install lower continuous extruded aluminum z clip rail to walls at level coordinated with the aluminum z clips attached to the back of the metal veneer panel. Provide clip spacing as recommendended by the manufacturer to support the actual weight of the panels.

3.03 PREPARATION FOR FIELD FINISHING

A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

3.04 TOLERANCES

A. Maximum Variation from True Position: 1/16 inch (1.6 mm).

B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.8 mm).

3.05 SCHEDULE

A. Schedule of Wood Paneling:
   1. WDP-01: Not used.
   2. WDP-02: Walnut flat paneling with surface-applied trim.
   3. WDP-03: Walnut reeded paneling.

END OF SECTION 06 42 00

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SECTION 06 83 16
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

B. Trim.

C. Stainless steel corner guards.

1.02 REFERENCE STANDARDS

A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples: Submit two samples 3 by 3 inch (75 x 75 mm) in size illustrating material and surface design of panels.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Panels: Quantity equal to 2 percent of total installed.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Marlite, Inc; Standard Smooth: www.marlite.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 9 feet (1.2 by 2.7 m), or lower heights depending on kitchen ceiling height.
   2. Panel Thickness: 0.09 inch (2.3 mm).
   3. Surface Design: Smooth.
   4. Color: As indicated in drawings.
   5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Class C; maximum flame spread index of 200 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Trim: Vinyl; color coordinating with panel.

C. Corner Guards: Stainless Steel
   1. Material thickness: 18 gage.
   2. Finish: No. 4

D. Fasteners: Nylon rivets.

E. Adhesive: Type recommended by panel manufacturer.

F. Sealant: Type recommended by panel manufacturer; color matching panel.

PART 3 EXECUTION

3.01 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Pre-drill fastener holes in panels, 1/8 inch (3.2 mm) greater in diameter than fastener, spaced as indicated by panel manufacturer.

D. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

E. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

F. Install panels with manufacturer's recommended gap for panel field and corner joints.

G. Drive fasteners to provide snug fit, and do not over-tighten.

H. Place trim on panel before fastening edges, as required.

I. Fill channels in trim with sealant before attaching to panel.

J. Install trim with adhesive and screws or nails, as required.

K. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

L. Remove excess sealant after paneling is installed and prior to curing.

3.02 SCHEDULE

A. Fiberglass Reinforced Plastic Panels:
   1. FRP-01: Color as indicated on drawings.
   2. FRP-02: Color as indicated on drawings.

END OF SECTION 06 83 16

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation at exterior wall behind interior wall finish.

B. Batt insulation for filling perimeter window and door shim spaces.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C; 2019a.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation on Inside of Concrete and Masonry Exterior Walls: Mineral fiber board.

2.02 FIBERBOARD INSULATION MATERIALS

A. Mineral Fiberboard Insulation: Rigid mineral fiber, in accordance with ASTM C612.
   1. Facing: None, unfaced.
   2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
   3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
   4. Board Thickness: 1-1/2 inches (38 mm).
   5. Board Edges: Square.
   6. Thermal Conductivity (k-factor): BTU inch/hr sq ft degrees F (W/m K) of 0.26 (0.037) per inch, minimum, at 75 degrees F (24 degrees C) when tested in accordance with ASTM C518.
   7. Maximum Density: 8 pcf (128 kg/cu m), nominal.
   8. Products:
      a. Johns Manville: www.jm.com/#sle.
      b. Owens Corning Corporation; Thermafiber : www.ocbuildingspec.com/#sle.
      c. ROCKWOOL (ROXUL, Inc); COMFORTBOARD 80: www.rockwool.com/#sle.
   9. Location: Interior side of exterior walls at first floor.

2.03 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
   1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
   2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
   3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
   4. Thermal Resistance: R-value of 13. R-value (RSI-value) of 13 (3.35).

5. Products:
    a. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
6. Location: Interior side of exterior walls (within stud cavity) as indicated on drawings..

B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Thermal Resisitance:
    a. Where indicated on drawings as 3-1/2 inch thickness: R-Value of 15.
    b. Where indicated on drawings as 6 inch thickness: R-Value of 24.
4. Products:
    a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
    b. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.

2.04 ACCESSORIES

A. Insulation Fasteners: Impaling clip of galvanized steel with washer retainer and clips, to be mechanically fastened to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of irregularities or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards vertically on walls.

B. Extend boards over expansion joints, unbonded to wall on one side of joint.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall and ceiling spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION 07 21 00

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, exterior penetrations, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

1.02 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 SUBMITTALS

A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

B. Samples: Submit two samples 3 by 3 inch (75 by 75 mm) in size illustrating metal finish color.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 PREFINISHED ALUMINUM SHEETS

A. Description: Factory-applied topcoat systems applied to aluminum flat sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed side and backing coats on unexposed side.

B. Aluminum Sheet Substrates: ASTM B209/B209M, alloy and temper as recommended by manufacturer for application.

C. High-Performance Organic Coating System: Comply with AAMA 2604 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured, 50-percent PVDF or silicone-modified polyester systems; tested for weathering for 5 years with 5 delta units color change maximum.

D. Application: Storefront opening flashing.
   1. Drawing Detail: As indicated on drawings.
   2. Base Metal Thickness: 0.040 inch (1.0 mm), minimum.
   3. Coating System: High-performance organic coating system.
   4. Color: As selected by Architect from manufacturer's standard colors.

E. Application: Flashing at painted wood trim.
   1. Drawing Detail: As indicated on drawings.
   2. Base Metal Thickness: 0.040 inch (1.0 mm), minimum.
   3. Coating System: High-performance organic coating system.
   4. Color: As selected by Architect from manufacturer's standard colors.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.03 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.04 ACCESSORIES

A. Primer Type: Zinc chromate.

B. Concealed Sealants: Non-curing butyl sealant.

C. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

PART 3 EXECUTION

3.01 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.02 INSTALLATION

A. Comply with drawing details.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

D. Seal metal joints watertight.

3.03 SCHEDULE

A. Flashings at window wall, door frame and window openings: as indicated on drawings.

END OF SECTION 07 62 00

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2024.

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.

E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.

F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus; 2025.

G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a, with Editorial Revision (2024).

H. ITS (DIR) - Directory of Listed Products; Current Edition.

I. FM (AG) - FM Approval Guide; Current Edition.

J. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

K. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

L. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

B. Product Data: Provide data on product characteristics, performance ratings, and limitations.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

C. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.

B. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.

C. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.

D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING FOR PERIMETER CONTAINMENT

2.04 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
   2. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping: Firestopping sealants.

B. Section 09 21 16 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C834 - Standard Specification for Latex Sealants; 2017.

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.

F. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.

G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.

H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).

I. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 SUBMITTALS

A. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Sample product warranty.

B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

E. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Field Quality Control Plan to be performed by Contractor:
   1. Visual inspection of entire length of sealant joints.
   2. Destructive field adhesion testing of sealant joints, except interior acrylic latex sealant.
      a. For each different sealant and substrate combination, allow for one test every 100 feet (30 m) in the first 1000 linear feet (305 linear m), and one test per 1000 linear feet (305 linear m) thereafter, or once per floor on each elevation.

b. If any failures occur in the first 1000 linear feet (305 linear m), continue testing at frequency of one test per 500 linear feet (152 linear m) at no extra cost to Owner.

B. Field Adhesion Test Procedures:
1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
5. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

C. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches (457 mm) long.
2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch (25.4 mm) by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a one year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
a. Wall expansion and control joints.
b. Joints between door, window, and other frames and adjacent construction.
c. Joints between different exposed materials.
d. Openings below ledge angles in masonry.
e. Other joints indicated below.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
a. Joints between door, window, and other frames and adjacent construction.
b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
c. Other joints indicated below.
3. Do not seal the following types of joints.
a. Intentional weepholes in masonry.
b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
d. Joints where installation of sealant is specified in another section.
e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.

2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
6. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Colors: As indicated on drawings.

2.03 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Color: To be selected by Architect from manufacturer's standard range.

B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Color: White.

C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 50 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.

D. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface .
1. Movement Capability: Plus and minus 35 percent, minimum.

E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: To be selected by Architect from manufacturer's standard range.

F. Non-Curing Butyl Sealant: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.

2.04 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Color: To be selected by Architect from manufacturer's standard range.

B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
   1. Movement Capability: Plus and minus 25 percent, minimum.
   2. Color: Gray.

2.05 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Open Cell: 40 to 50 percent larger in diameter than joint width.
   4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.03 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet (300 linear m), notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

D. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION 07 92 00

SECTION 08 06 71
DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Preliminary schedule of door hardware sets for swinging and sliding as indicated on drawings.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware: Requirements to comply with in coordination with this section.

1.03 REFERENCE STANDARDS

A. BHMA A156.3 - American National Standard for Exit Devices; 2014.

B. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

C. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

D. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Comply with submittal requirements as indicated in Section 08 71 00.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Only manufacturers listed in Door Hardware Schedule or Section 08 71 00 are considered acceptable, unless noted otherwise.
   1. Substitutions: See Section 01 60 00 - Product Requirements.

B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.

C. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 71 00.
   1. AR - Adams Rite.
   2. EMT - Emtek
   3. HGR - Hager.
   4. HES - HES.
   5. INT - International Door Closers
   6. LCN - LCN.
   7. ROC - Rockwood.
   8. SCH - Schlage.

2.02 DESCRIPTION

A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
   1. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
   2. Necessary items that are not included in a Hardware Set should be added and have the appropriate additional hardware as required for proper application and functionality.
   3. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
   4. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.03 LOCK FUNCTION CODES

A. Function Codes for Mortise Locks: Complying with BHMA A156.13.
   1. Code F04: Entry/Office Lock: Deadlocking latch bolt by knobs except when outside knob is locked by buttons in face (edge), then by key outside.
   2. Code F07; Storeroom/Exit Lock: Deadlocking latch bolt by inside knob or key outside. Outside knob rigid.

3. Code F08; Front Door Lock: Latch bolt is operated by knob from either side except when outside knob is made inoperative by a stop or mechanical means other than key. Deadbolt is operated by turn inside. Key outside operates both locks.
4. Code F16; Deadlock: Deadbolt by key from either side.
5. Code F32; Classroom security lock, interior/exterior lockdown.
6. Code S01; Key cylinder only, no lever outside. Lever-only inside. Latchbolt retracted by lever from inside. Key outside retracts latchbolt.

B. Function Codes for Exit Devices: Complying with BHMA A156.3.
1. Code 05; Exit Device: Entrance by thumbpiece. Key (pullside) locks/unlocks thumbpiece.

2.04 FINISHES

A. Finishes: Complying with BHMA A156.18.
1. Code 613: Oil rubbed bronze on brass or bronze base material (former US equivalent US10B).

PART 3 EXECUTION

3.01 DOOR HARDWARE SCHEDULE

A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated.

3.02 HARDWARE SET # 1.0: "MAIN RESTAURANT EXTERIOR ENTRY"

A. For use on Door Number(s): 100A.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
8		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1		Flush Bolt Set	FB-1200 Top and Bottom	DU	INT
1	F16	Deadlock	1853 Mortise Deadlock	313	AR
2		Back-to-Back Pull	RM 3302, 48" Long, Type 5HD	613	ROC
2		Surface Closer	1460 Parallel Arm, Push Side	695	LCN
1		Perimeter Seal	By Storefront Manufacturer		
1		Astragal Seal	By Storefront Manufacturer		
1		Threshold Seal	By Storefront Manufacturer		

C. ERight hand leaf is active leaf.

3.03 HARDWARE SET # 2.0: "ELEVATOR LOBBY ENTRANCE FOR OFFICE"

A. For use on Door Number(s): 100B.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F32	Classroom Lockset	Mortise Lockest L9071	613	SCH
1		Electric Strike w/ WIreless Card Reader Kit	Aperio ES1500-15MLH	630	HES
1		Concealed Closer	2010-3038B	695	LCN
1		Kickplate	Push Side, 10" x 36"	613	ROC

C. Note: Elevator lobby side of door is secure (exterior) side.

3.04 HARDWARE SET # 3.0: "RESTAURANT ENTRANCE SLIDING DOORS"

A. For use on Door Number(s): 100C.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
2		Pocket Door Track	9878HD-72 4-1/2" x 4-1/2"	628	HGR
1		Pocket Door Lock	Modern Retangular Pocket	613	EMT

			Door Mortise Lock, Single Cylinder		

3.05 HARDWARE SET # 4.0: "STORAGE CLOSET"

A. For use on Door Number(s): 101A.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F07	Storeroom Lockset	Mortise Lockest L9080	613	SCH
1		Surface Closer	1460 Parallel Arm, Push Side	695	LCN
1		Kickplate	Push Side, 10" x 36"	613	ROC
1		Floor Stop	470	613	ROC

3.06 HARDWARE SET # 5.0: "RESTAURANT EMERGENCY EXIT"

A. For use on Door Number(s): 101B.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
8		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
2	05	Exit Device	12-9456-866-FLW	613	SA
2		Surface Closer	1460, Parallel Arm, Push Side	695	LCN
1		Perimeter Seal	By Storefront Manufacturer		
1		Astragal Seal	By Storefront Manufacturer		
1		Threshold Seal	By Storefront Manufacturer		

3.07 HARDWARE SET # 5.1: "KITCHEN ACCESS AND SERVICE DOOR"

A. For use on Door Number(s): 106C.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
8		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	05	Exit Device	12-9456-866-FLW	613	SA
1		Flush Bolt	FB-1200	BK	INT
1		Surface Closer	1460, Parallel Arm, Push Side	695	LCN
1		Perimeter Seal	By Storefront Manufacturer		
1		Astragal Seal	By Storefront Manufacturer		
1		Threshold Seal	By Storefront Manufacturer		

C. Exit Device and Closer on active leaf, RHR.

3.08 HARDWARE SET # 6.0: "OFFICE TO RESTAURANT "SECRET" ENTRANCE"

A. For use on Door Number(s): 103B.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
8		Butt Hinges	4-1/2" x 6" Wide Throw	613	HGR
1		Flush Bolt Set	FB-1200 Top and Bottom	DU	INT
1	S01	Exit Lock w/ Cylinder	Mortise Lockset L9026	613	SA
1		Electric Strike w/ WIreless Card Reader Kit	Aperio ES1500-15MLH	630	HES
2		Surface Closer	1460 Parallel Arm, Push Side	695	LCN
2		Kickplate	Push Side, 10" x 36"	613	ROC
2		Floor Stop	470	613	ROC

C. Note: Restaurant of door is secure (exterior) side. Left hand door is active leaf.

3.09 HARDWARE SET # 7.0: "ELECTRICAL ROOM EXIT"

A. For use on Door Number(s): 104.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F08	Exit Device, Rim	3828-C-LL	613	SA
1		Surface Closer	1460 Parallel Arm, Push Side	695	LCN
1		Kickplate	Push Side, 10" x 36"	613	ROC
1		Floor Stop	470	613	ROC

3.10 HARDWARE SET # 8.0: "RESTROOM ENTRANCES"

A. For use on Door Number(s): 112, 113.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F16	Deadbolt	Mortise Double Cylinder L9462	613	SCH
1		Push Plate	76B	613	ROC
1		Door Pull	178	613	RPC
1		Concealed Closer	2010-3038B	695	LCN
1		Kickplate	10" x 36"	613	ROC
1		Floor Stop	441	613	ROC

3.11 HARDWARE SET # 9.0: "STAFF ACCESS DOOR"

A. For use on Door Number(s): 109,117.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F04	Entrance/Office Lock	Mortise Lockset L9050	613	SCH
1		Surface Closer	1460 Regular Arm, Pull Side	695	LCN
2		Kickplate	10" x 36", ea. side	613	ROC
1		Floor Stop	441	613	ROC

3.12 HARDWARE SET # 9.1: "STAFF RESTROOM"

A. For use on Door Number(s): 116.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
3		Butt Hinges	4-1/2" x 4-1/2"	613	HGR
1	F04	Entrance/Office Lock w/ Privacy Indicator	Mortise Lockset L9050 with XL13-439	613	SCH
1		Surface Closer	1460 Parallel Arm, Push Side	695	LCN
2		Kickplate	10" x 36", ea. side	613	ROC
1		Floor Stop	441	613	ROC

3.13 HARDWARE SET # 10.0: "EXISTING EXTERIOR OFFICE DOOR - CARD READER"

A. For use on Door Number(s): 103A.

B. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
1		Electric Strike w/ Wireless Card Reader Kit	Aperio ES1500-15MLH	630	HES

C. Balance of existing hardware to remain

3.14 HARDWARE SET # 11.0: "SECOND FLOOR STORAGE"

A. For use on Door Number(s): 202.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
4		Butt Hinges	4-1/2" x 4-1/2"	613	McK
1	F07	Storeroom Lock	Mortise Lockest L9080	613	SA
1		Floor Stop	470	613	ROC

3.15 HARDWARE SET # 12.0: "SECOND FLOOR CONFERENCE ROOM"

A. For use on Door Number(s): 221.

B. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
4		Butt Hinges	4-1/2" x 4-1/2"	652	McK
1	F06	Classroom Lock	L9070	613	SCH
1		Overhead Closer	Pull Side, Regular Arm, Stop	695	NOR
1		Kickplate	Push Side, 10" x 36"	613	ROC
1		Floor Stop	470	613	ROC

END OF SECTION 08 06 71

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SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

1.03 ABBREVIATIONS AND ACRONYMS

A. ANSI: American National Standards Institute.

B. HMMA: Hollow Metal Manufacturers Association.

C. NAAMM: National Association of Architectural Metal Manufacturers.

D. NFPA: National Fire Protection Association.

E. SDI: Steel Door Institute.

F. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2017.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2020.

J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

K. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2007.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least ten years of documented experience.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Thermal Performance: Minimum assembly U-value: 0.37.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 1 - Standard-duty.
      b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
      c. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 20 gauge, 0.032 inch (0.8 mm), minimum.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 18 gage, 0.042 inch (1.0 mm), minimum.

D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

A. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

B. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

C. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Coordinate frame anchor placement with wall construction.

C. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

D. Install door hardware as specified in Section 08 71 00.

E. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 11 13

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SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

B. Section 09 91 23 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).

C. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for 2 years.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, and defective materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Graham Wood Doors: www.grahamdoors.com/#sle.
   2. Masonite Architectural: www.architectural.masonite.com/#sle.
   3. VT Industries, Inc: www.vtindustries.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Medium-Density Overlay (MDO) Faced Doors for Opaque Finish:
   1. Masonite Architectural; Aspiro Premium Painted Doors: www.architectural.masonite.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.

2. Wood veneer facing with factory transparent finish as indicated on drawings.
3. Wood veneer facing for field opaque finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: WD-01: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
   1. Vertical Edges: Same species as face veneer.
   2. "Running Match" each pair of doors and doors in close proximity to each other.
   3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet (3 m) of each other when doors are closed.

B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
   1. Exception: Doors to be field finished.

E. Provide edge clearances in accordance with the quality standard specified.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Field-Finished Doors: Trimming to fit is acceptable.
   1. Adjust width of non-rated doors by cutting equally on both jamb edges.
   2. Trim maximum of 3/4 inch (19 mm) off bottom edges.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 14 16

SECTION 08 14 33
STILE AND RAIL WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors, stile and rail design; non-fire rated.

B. Panels of wood.

1.02 RELATED REQUIREMENTS

A. Section 06 20 00 - Finish Carpentry: Wood door frames.

B. Section 08 71 00 - Door Hardware.

C. Section 09 91 23 - Interior Painting: Field finishing.

1.03 REFERENCE STANDARDS

A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

B. WDMA I.S. 6A - Interior Architectural Wood Stile and Rail Doors; 2021, with Errata (2022).

1.04 SUBMITTALS

A. Product Data: Indicate stile and rail core materials and construction; veneer species, type and characteristics.

B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required , special beveling , special blocking for hardware , factory finishing criteria , identify cutouts for glazing.

C. Samples: Submit two samples of door veneer, 6 x 6 inch (150 x 150 mm) in size illustrating wood grain, stain color, and sheen.

D. Manufacturer's qualification statement.

E. Installer's qualification statement.

F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver, and store doors in accordance with quality standard specified.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, and defective materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stile and Rail Wood Doors:
   1. Masonite Architectural: www.architectural.masonite.com/#sle.
   2. TruStile, A Marvin Brand: www.trustile.com/#sle.
   3. VT Industries, Inc: www.vtindustries.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS

A. Quality Standard: Premium Grade, Heavy Duty performance, in accordance with WDMA I.S. 6A.

B. Exterior Doors: 1-3/4 inches (44.45 mm) thick unless otherwise indicated; solid lumber construction; mortise and tenon joints; water repellent treated. Opaque finish.

C. Interior Doors: 1-3/4 inches (44.45 mm) thick unless otherwise indicated; solid lumber construction; mortise and tenon joints. Opaque finish.

D. Wood veneer facing for field opaque finish as indicated on drawings.

2.03 DOOR AND PANEL FACINGS

A. Materials for Opaque Finishes: Medium density fiberboard (MDF).

B. Adhesive: Type II - Water Resistant.

2.04 DOOR CONSTRUCTION

A. Astragals for Double Doors: Wood, square shaped, overlapping and recessed at face edge, specifically for double doors.

B. Vertical Exposed Edge of Stiles: Hardwood for paint finish.

C. Panels: Flat.

D. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.

2.05 ACCESSORIES

A. Wood Door Frames: See Section 06 20 00.

B. Glazed Openings:
   1. Tempered Glass: ASTM C1048.
   2. Glazing: Single vision units, 1/4 inch (6.4 mm) thick panes of glass.
   3. Tint: Clear.

C. Panel or Glass Retention Molding: Wood of same species as door facing, flat bead stop, with mitered corners; prepared for countersink style tamper proof screws.

D. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out of tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standards.

B. Field-Finished Doors: Trimming to fit is acceptable.
   1. Adjust width of non-rated doors by cutting equally on both jamb edges.
   2. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).

C. Machine cut for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

3.03 TOLERANCES

A. Comply with specified quality standard for fit, clearance, and joinery tolerances.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

B. See Door and Frame Schedule appended to this section.

END OF SECTION 08 14 33

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SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall mounted access units.

B. Ceiling mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Field paint finish.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit, for custom ceiling access panels with gypsum board inlay.

D. Project Record Documents: Record actual locations of each access unit.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall Mounted Units:
   1. Location: As required for access to in-wall plumbing fixtures, valves, and HVAC components.
   2. Panel Material: Steel.
   3. Size: 12 inch by 12 inch (305 mm by 305 mm) unless larger size is required for proper maintenance access.
   4. Door/Panel: Hinged, standard duty, with concealed mechanical touch latch.
   5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface recessed for infill with wall finish.

B. Ceiling Mounted Units and large format Wall-Mounted Units:
   1. Location: As required for access to in ceiling plumbing fixtures, valves, and HVAC components.
   2. Panel Material: Aluminum extrusions with gypsum board inlay.
   3. Size: As indicated on drawings.
   4. Door/Panel: Hinged, standard duty, with concealed mechanical touch latch.
   5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface recessed for infill with ceiling finish.

C. Wall-Mounted Units in Wet Areas:
   1. Location: As required or access to in-wall fixtures and valves within restrooms.
   2. Panel Material: Stainless steel, Type 304.
   3. Size: 12 by 12 inches (305 by 305 mm) unless a larger size is required for proper maintenance access.
   4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface. Coordinate with tile finishes at restrooms..

D. Fire-Rated Wall-Mounted Units:
   1. Location: At fire-resistance rated partitions and shafts.
   2. Wall Fire-Rating: As indicated on drawings.
   3. Panel Material: Steel.
   4. Size: 12 by 12 inches (305 by 305 mm).
   5. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface recessed for infill with wall finish.
7. Installation: Install 12 inches above floor level.

2.02 WALL AND CEILING MOUNTED ACCESS UNITS

A. Manufacturers:
1. Babcock-Davis; Architectural Access Door: www.babcockdavis.com/#sle.
   a. Stainless Steel Access Doors: BN-T-C-X-S.
2. Bauco Access Panel Solutions Inc: www.accesspanelsolutions.com/#sle.
   a. Concealed Hardware and Gypsum Board Inlay: Bauco Plus II - Access Panels.
3. Best Access Doors: www.bestaccessdoors.com/#sle.
   a. Fire-Rated Insulated Access Panel with Mud-In Flange: Best Access Doors; Series BA-FRI-DF.
4. FF Systems, Inc: www.ffsystemsinc.com/#sle.
   a. Non-Removable, with Drywall Inlay: FF Systems; System F1.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall Mounted Units at restroom and kitchen locations: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Stainless steel, Type 304.
2. Style: Exposed frame with door surface flush with frame surface.
3. Door Style: Single thickness with rolled or turned in edges.
4. Frames: 16 gauge, 0.0598 inch (1.52 mm), minimum thickness.
5. Single Steel Sheet Door Panels: 1/16 inch (1.6 mm), minimum thickness.
6. Stainless Steel Finish: No. 4 brushed finish.
7. Hardware:
   a. Hardware for Fire-Rated Units: As required for listing.
   b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.
   c. Latch/Lock: Screw driver slot for quarter turn cam latch.
   d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION 08 31 00

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Infill panels of metal and glass.

C. Aluminum doors and frames.

D. Weatherstripping.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.

C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.

B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.

C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

H. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.

I. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).

J. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

K. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes; 2020.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

E. Test Reports: Submit certified test reports showing compliance with specified performance characteristics, including design wind loads, and other physical properties.

F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

H. Manufacturer's Qualification Statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and capable of providing field service representation during construction process.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress.

B. Do not install sealants when ambient temperature is less than 40 degrees F (5 degrees C). Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

C. Provide one year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: EFCO Corporation: www.efcocorp.com/.

B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers:
   1. Kawneer North America: www.kawneer.com/#sle.
   2. YKK Corporation: www.ykkap.com/.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

A. Center-Set Style, Thermally Broken, Wind-Borne-Debris Resistance Tested:
   1. Basis of Design: EFCO Series 526 (T).
   2. Vertical Mullion Dimensions: 2-1/2 inches wide by 5 inches deep (63 mm wide by 127 mm deep).
   3. Thermally improved.

2.03 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING - FUTURE WORK

A. Center-Set Style:
   1. Basis of Design: EFCO Series 401 (NT).

B. Front-Set Style:
   1. Vertical Mullion Dimensions: 1-3/4 inches wide by 4-1/2 inches deep (44 mm wide by 114 mm deep).

2.04 BASIS OF DESIGN -- SWINGING DOORS

A. Wind-Borne-Debris Resistance Tested, Wide-Stile, Laminated Glazing:

1. Basis of Design: EFCO: Model D300.
2. Thickness: 1-3/4 inches (43 mm).

B. Narrow Stile, Monolithic Glazing:
1. Basis of Design: EFCO: Model D200.
2. Thickness: 1-3/4 inches (43 mm).

2.05 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
2. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
3. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
4. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
5. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
6. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. PERFORMANCE REQUIREMENTS
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Design Wind Loads: Comply with requirements of ASCE 7.
b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.4;4
2. Wind-Borne-Debris Resistance: Identical full-size glazed assembly without auxiliary protection, tested by independent agency in accordance with ASTM E1996 for Wind Zone 3 - Enhanced Protection for Large and Small Missile impact and pressure cycling at design wind pressure.
3. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf (390 Pa).
4. Air Leakage: 0.06 cfm/sq ft (0.3 L/sec sq m) maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure difference.

2.06 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. Glazing: See Section 08 80 00.

C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
1. Finish: Same as storefront.

D. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches (43 mm).
2. Glazing Stops: Square.
3. Finish: Same as storefront.

2.07 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Fasteners: Stainless steel.

D. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.08 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Color: Dark bronze.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.09 HARDWARE

A. For each exterior door, include weatherstripping, sill sweep strip, and threshold.

B. Other Door Hardware: See Section 08 71 00.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all exterior doors.

D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all exterior doors.

E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all exterior doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet (1.5 mm per m) non-cumulative or 0.06 inch per 10 feet (1.5 mm per 3 m), whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).

3.04 FIELD QUALITY CONTROL

A. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
   1. Perform a minimum of two tests in each designated area as directed by Architect.
   2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

B. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

3.07 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION 08 43 13

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SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for wood, aluminum, and hollow metal doors. See Section 08 06 71 for Schedule

B. Hardware for fire-rated doors.

C. Electrically operated and controlled hardware.

D. Thresholds.

E. Weatherstripping and gasketing.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.

B. Section 08 06 71 - Door Hardware Schedule: Schedule of door hardware sets.

C. Section 08 11 13 - Hollow Metal Doors and Frames.

D. Section 08 14 16 - Flush Wood Doors.

E. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware not specified in Hardware Schedule Section.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. BHMA A156.1 - Butts and Hinges; 2021.

C. BHMA A156.3 - American National Standard for Exit Devices; 2014.

D. BHMA A156.4 - Door Controls - Closers; 2019.

E. BHMA A156.5 - American National Standard for Cylinders and Input Devices for Locks; 2014.

F. BHMA A156.6 - Architectural Door Trim; 2021.

G. BHMA A156.7 - American National Standard for Template Hinge Dimensions; 2016.

H. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; 2017.

I. BHMA A156.14 - American National Standard for Sliding and Folding Door Hardware; 2013.

J. BHMA A156.16 - American National Standard for Auxiliary Hardware; 2018.

K. BHMA A156.18 - American National Standard for Materials and Finishes; 2016.

L. BHMA A156.21 - American National Standard for Thresholds; 2014.

M. BHMA A156.22 - Gasketing; 2021.

N. BHMA A156.28 - American National Standard for Recommended Practices for Mechanical Keying Systems; 2018.

O. BHMA A156.31 - American National Standard for Electric Strikes and Frame Mounted Actuators; 2013.

P. DHI (H&S) - Sequence and Format for the Hardware Schedule; 1996.

Q. DHI (KSN) - Keying Systems and Nomenclature; 1989.

R. ITS (DIR) - Directory of Listed Products; Current Edition.

S. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.

U. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.

V. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

W. UL (DIR) - Online Certifications Directory; Current Edition.

X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
   1. Architect.
   2. Installer's Architectural Hardware Consultant (AHC).
   3. Hardware Installer.
   4. Owner's Security Consultant.

C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

D. Keying Requirements Meeting:
   1. Schedule meeting at project site prior to Contractor occupancy.
   2. Attendance Required:
      a. Contractor.
      b. Owner.
      c. Architect.
      d. Hardware Installer.
      e. Owner's Security Consultant.
   3. Agenda:
      a. Establish keying requirements.
      b. Verify locksets and locking hardware are functionally correct for project requirements.
      c. Verify that keying and programming complies with project requirements.
      d. Establish keying submittal schedule and update requirements.
   4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
      a. Access control requirements.
      b. Key control system requirements.
   5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
   6. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.

C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
   1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
   2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
   3. List groups and suffixes in proper sequence.
   4. Provide complete description for each door listed.
   5. Provide manufacturer's and product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
   6. Include account of abbreviations and symbols used in schedule.

D. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
   1. Submit manufacturer's parts lists and templates.
   2. Bitting List: List of combinations as furnished.

E. Keying Schedule:
   1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.
   1. Closers: Five years, minimum.
   2. Exit Devices: Three years, minimum.
   3. Locksets and Cylinders: Three years, minimum.
   4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:
   1. Applicable provisions of federal, state, and local codes.
   2. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
   3. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
   4. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

E. Fasteners:
   1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
      a. Aluminum fasteners are not permitted.
      b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
   2. Fire-Rated Applications: Comply with NFPA 80.
      a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
      b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

2.02 HINGES

A. Manufacturers:
   1. Basis of Design: Standard: Hager 1279; Ball bearing where indicated: Hager BB1168.
   2. McKinney; an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Hager Companies: www.hagerco.com/#sle.
   4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Hinges: Comply with BHMA A156.1, Grade 1.
   1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
      a. Provide hinge width required to clear surrounding trim.
   2. Provide hinges on every swinging door.
   3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
   4. Provide ball-bearing hinges at each door with closer.
   5. Provide non-removable pins on exterior outswinging doors.
   6. Provide power transfer hinges where electrified hardware is mounted in door leaf.
   7. Provide following quantity of butt hinges for each door:
      a. Doors up to 60 inches (1.5 m) High: Two hinges.

b. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
c. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.
d. Doors over 120 inches (3 m) High: One additional hinge per each additional 30 inches (762 mm) in height.
e. Dutch Doors: Minimum two hinges each leaf, follow guidelines above for hinges quantity.

2.03 TRACK AND HANGERS

A. Manufacturers:
1. Basis of Design: Hager 9800 Series.
2. Hager Companies: www.hagerco.com/#sle.
3. Johnson Hardware: www.johnsonhardware.com/#sle.
4. Knape & Vogt: www.kv.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Pocket Doors: Provide pocket door kit, including header assembly, split studs, hangers, door hanger plates, bumper, guides, floor plate, and end bracket.
1. Provide flush cup pull on both sides.
2. Provide edge pull in leading edge.

C. Sliding and Bifolding Door Hardware: Comply with BHMA A156.14.
1. Provide track, hanger fasteners, guides, and pulls; size track and hangers in accordance with manufacturer's recommendations for weight of doors.
2. Provide one lockable pull for each pair of panels hinged together.

D. Door Weight: Medium; medium frequency of use with 150 to 200 lbs door weight.

2.04 FLUSH BOLTS

A. Manufacturers:
1. Basis of Design: International Door Closers, Inc: www.intldoorclosers.com/#sle.
2. Adams Rite, an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Flush Bolts: Comply with BHMA A156.16, Grade 1.
1. Flush Bolt Throw: 5/8 inch (16 mm), minimum.
2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.
a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Provide lever extensions for top bolt at over-sized doors.

2.05 EXIT DEVICES

A. Manufacturers:
1. Basis of Design: Public Doors: Sargent 90 Series; Back-of-House Doors: Sargent 30 Series.
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
4. Von Duprin, an Allegion brand: www.allegion.com/us/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
2. Provide cylinder with cylinder dogging or locking trim.
3. Provide exit devices properly sized for door width and height.
4. Provide strike as recommended by manufacturer for application indicated.
5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.06 ELECTRIC STRIKES

A. Manufacturers:
1. Basis of Design: HES Aperio ES100-15 Wireless Electric Strike with Card Reader Kit.
2. HES or Securitron; an Assa Abloy Group company: www.assaabloydss.com/#sle.

3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.

2.07 LOCK CYLINDERS

A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
1. Provide standard type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
2. Provide cylinders from same manufacturer as locking device.
3. Provide cams and/or tailpieces as required for locking devices.
4. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.08 MORTISE LOCKS

A. Manufacturers:
1. Basis of Design: Schlage L Series.
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Schlage, an Allegion brand: www.allegion.com/us/#sle.
4. Stanley, dormakaba Group: www.stanleyhardwarefordoors.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
a. Finish: To match lock or latch.
5. Provide at exterior doors unless otherwise provided with exit device.

2.09 DOOR PULLS AND PUSH PLATES

A. Manufacturers:
1. Basis of Design: As indicated in Door Hardware Schedule.
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Door Pulls and Push Plates: Comply with BHMA A156.6.
1. Pull Type: Straight, unless otherwise indicated.
2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
a. Edges: Beveled, unless otherwise indicated.
3. Material: Aluminum, unless otherwise indicated.
4. On glazed storefront doors, provide matching door pulls/push plates on both faces unless otherwise indicated.

2.10 CLOSERS

A. Manufacturers; Surface Mounted:
1. Basis of Design: LCN 1460 Series.
2. Sargent; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. DORMA USA, Inc: www.dorma.com/#sle.
4. LCN, an Allegion brand: www.allegion.com/us/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Manufacturers; Concealed - Overhead:
1. Basis of Design: LCN 2010 Series.
2. DORMA USA, Inc: www.dorma.com/#sle.

3. LCN, an Allegion brand: www.lcnclosers.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Closers: Comply with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
2. Provide door closer on each exterior door.
3. Provide door closer on each fire-rated and smoke-rated door.
4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
5. At corridor entry doors, mount closer on room side of door.
6. At outswinging exterior doors, mount closer on interior side of door.

2.11 KICK PLATES

A. Manufacturers:
1. Basis of Design: As indicated in Door Hardware Schedule.
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Ives, an Allegion brand: www.allegion.com/us/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
1. Size: 10 inch (254 mm) high by 2 inch (51 mm) less door width (LDW) on push side of door, unless otherwise noted in Door Hardware Schedule.

2.12 FLOOR STOPS

A. Manufacturers:
1. Basis of Design: As indicated in Door Hardware Schedule.
2. Rockwood; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
2. Type: _____, with stem floor stop.
3. Material: Aluminum housing with rubber insert.

2.13 THRESHOLDS

A. Manufacturers:
1. Basis of Design: Pemko 171 Series.
2. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. National Guard Products, Inc: www.ngpinc.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Thresholds: Comply with BHMA A156.21.
1. Provide threshold at each exterior door, unless otherwise indicated.
2. Type: Half-threshold.
3. Material: Aluminum.
4. Threshold Surface: Smooth and flat.
5. Field cut threshold to profile of frame and width of door sill for tight fit.
6. Provide non-corroding fasteners at exterior locations.

2.14 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
1. Basis of Design: Pemko S88-BL.
2. Pemko; an Assa Abloy Group company: www.assaabloydss.com/#sle.
3. Hager Companies: www.hagerco.com/#sle.
4. National Guard Products, Inc: www.ngpinc.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
   1. Head and Jamb Type: Self-adhesive.
   2. Door Sweep Type: Door shoe.
   3. Material: Aluminum, with brush weatherstripping.
   4. Provide gasketing for smoke and draft control doors Indicated as "20 MIN" doors in drawings. that complies with local codes, requirements of assemblies tested in accordance with UL 1784.
   5. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
   6. Provide door bottom sweep on each exterior door, unless otherwise indicated.
   7. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

2.15 KEY CONTROL SYSTEMS

A. Key Control Systems: Comply with guidelines of BHMA A156.28.
   1. Provide keying information in compliance with DHI (KSN) standards.
   2. Keying: Grand master keyed.
   3. Key to existing keying system.
   4. Supply keys in following quantities:
      a. 4 each Master keys.
      b. 1 each Grand Master keys.
      c. 15 each Construction keys.
      d. 2 each Change keys for each keyed core.
   5. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
   6. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."

2.16 FINISHES

A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
   1. Primary Finish: 613; dark oxidized satin bronze, oil rubbed, with bronze base material (former US equivalent US10B); BHMA A156.18.
   2. Exceptions:
      a. Where base material metal is specified to be different, provide finish that is an equivalent appearance in accordance with BHMA A156.18.
      b. Hinges for Fire-Rated Doors: Steel base material with painted finish, in compliance with NFPA 80.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Do not install surface mounted items until application of finishes to substrate are fully completed.

F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.
   1. Mounting heights in compliance with ADA Standards:
      a. Locksets: 35 inch (889 mm).
      b. Push Plates/Pull Bars: 42 inch (1067 mm).
      c. Exterior Pull Bars: 40 inch (1016 mm).

d. Deadlocks (Deadbolts): 43 inch (1029 mm), unless pull interferes, in which case install above pull, maximum 48 inch (1219 mm). At exterior doors with Pull Bar, install below pull, min 15 inch (381 mm), above floor.
e. Exit Devices: 35 inch (889 mm).

G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
1. Refer to Section 07 92 00 for additional requirements.

3.03 ADJUSTING

A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.04 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.05 PROTECTION

A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 71 00

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units, monolithic tempered and laminated.

C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

B. Section 08 43 13 - Aluminum-Framed Storefronts.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

F. ASTM C1036 - Standard Specification for Flat Glass; 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.

I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.

J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.

M. GANA (SM) - GANA Sealant Manual; 2008.

N. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2020.

O. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2020.

P. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2017.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

C. Samples: Submit two samples 12 by 12 inch (300 by 300 mm) in size of glass units.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7-10.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   4. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
   1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
   5. Impact Resistant Safety Glass: Complies with ANSI Z97.1 - Class B, or 16 CFR 1201 - Category I criteria.
   6. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
   2. Polyvinyl Butyral (PVB) Interlayer: 0.060 inch (1.524 mm) thick, minimum.

2.03 INSULATING GLASS UNITS

A. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Metal Edge Spacers: Aluminum, bent and soldered corners.
   4. Spacer Color: Gray.
   5. Edge Seal:

a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
b. Color: Gray.

6. Purge interpane space with dry air, hermetically sealed.

B. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: As required to meet performance requirements, 1/4 inch (6.4 mm) thick, minimum.
a. Tint: Clear.
b. Coating: Low-E (passive type), on #2 surface.
1) Basis-of-Design: Vitro Architectural Glass, Solarban 70.
4. Inboard Lite: Laminated float glass, 9/16 inch thick, minimum.
a. Tint: Clear.
5. Total Thickness: 1-5/16 inch (33.33 mm).
6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.28, nominal.
7. Visible Light Transmittance (VLT): 79 percent, nominal.
8. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.

2.04 GLAZING UNITS

A. Type LG-1 - Exterior Security Glazing: Laminated glass, 2-Ply.
1. Applications: Locations as indicated on drawings.
2. Tint: Clear.
3. Thickness: 9/16 inch (14.2 mm).
4. Outer Lite: Heat-strengthened glass.
a. Coating: Low-E (passive type) on #2 surface.
1) Basis-of-Design: Vitro Architectural Glass, Solarban 70.
5. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
6. Inside Lite: Heat-strengthened glass.
7. Visible Light Transmittance (VLT): 79 percent, nominal.
8. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.

2.05 GLAZING COMPOUNDS

A. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; gray color.

B. Butyl Sealant: Single component; ASTM C920 Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.

C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; black color.

2.06 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.

D. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

3.04 INSTALLATION - WET GLAZING METHOD (SEALANT AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Place setting blocks at 1/4 points and install glazing pane or unit.

C. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch (610 mm) intervals, 1/4 inch (6.4 mm) below sight line.

D. Fill gaps between glazing and stops with silicone type sealant to depth of bite on glazing, but not more than 3/8 inch (9 mm) below sight line to ensure full contact with glazing and continue the air and vapor seal.

E. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.05 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch (610 mm) centers, kept 1/4 inch (6 mm) below sight line.

C. Locate and secure glazing pane using glazers' clips.

D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.06 INSTALLATION - WET/DRY GLAZING METHOD (PREFORMED TAPE AND SEALANT)

A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.

B. Cut glazing tape to length and set against permanent stops, 3/16 inch (5 mm) below sight line. Seal corners by butting tape and dabbing with butyl sealant.

C. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.

D. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

E. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.

F. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch (6.4 mm) below sight lines.
   1. Place glazing tape on glazing pane of unit with tape flush with sight line.

G. Fill gap between glazing and stop with silicone type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.

H. Apply cap bead of silicone type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.07 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.08 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00

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SECTION 08 83 00
MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass.
   2. Tempered safety glass where indicated on drawings.

1.02 RELATED REQUIREMENTS

A. Section 10 28 00 - Toilet, Bath, and Laundry Accessories: Metal mirror frames.

1.03 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

1.05 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.

B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
   1. Thickness: 1/4 inch (6.4 mm).
   2. Edges: Arrised.
   3. Size: As indicated on drawings.

C. Antiqued Mirror Glass: Annealed float glass.
   1. Basis-of-Design Fabricator: Dependable Glass Works, (985) 892-0999
   2. Acceptable Range of samples from Fabricator:
      a. DGS-076
      b. DGS-110
      c. DGS-111
      d. DGS-112
      e. DGS-249

2.02 GLAZING COMPOUNDS

A. Acrylic Sealant: ASTM C920, Type S, Grade NS, Class 12-1/2, Uses M and A; single component, solvent curing, non-bleeding; cured Shore A hardness of 15 to 25; clear color.

B. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; color as selected.

2.03 ACCESSORIES

A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.

C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.

D. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
   1. Application Temperature: Minus 35 to 140 degrees F (Minus 37 to 60 degrees C) at contact surfaces.
   2. Volatile Organic Content (VOC): Less than 7 percent by weight.

E. Channel Frame: One piece, channel frame, stainless steel, Type 430, satin finish, 1/2 inch by 1/2 inch by 3/8 inch deep (12.7 mm by 12.7 mm by 9.5 mm deep) with 90 degree mitered corners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings for mirrored glazing are correctly sized and within tolerance.

B. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous mirror frames or recesses with substrate compatible primer or sealer. Prime surfaces scheduled to receive sealant.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.

C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

D. Installation in Frames:
   1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
   2. Place setting blocks at one-quarter points with edge block no more than 6 inches (152 mm) from corners.
   3. Rest mirrors on setting blocks and push against tape to ensure full contact at perimeter of mirror.
   4. Install removable stops, insert spacer shims between mirrors, and apply stops at 24 inches (610 mm) on center and at 1/4 inch (6.4 mm) below sight line.
   5. Fill gaps between mirror and applied stop with sealant to depth equal to bite on glazing, to uniform and level line.
   6. Trim protruding tape edge.

E. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

A. Remove wet glazing materials from finish surfaces.

B. Remove labels after work is complete.

C. Clean mirrors and adjacent surfaces.

END OF SECTION 08 83 00

SECTION 08 91 00
LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 43 13 - Aluminum-Framed Storefronts: Prepared openings for louvers.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2015.

C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.

D. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior and interior surfaces.

E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
   1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers:
   1. Airolite Company, LLC: www.airolite.com/#sle.
   2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
   3. Ruskin: www.ruskin.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf (of 1.2 kPa) without damage or permanent deformation.
   2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft (3.1 g/sq m) water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
   3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   4. Screens: Provide bird screens at intake and exhaust louvers.

B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame.
   1. Free Area: 40 percent, minimum.
   2. Blades: Inverted Y.
   3. Frame: 4 inches deep (100 mm deep), channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
   4. Aluminum Thickness: Frame 12 gage, 0.0808 inch (2.05 mm) minimum; blades 12 gage, 0.0808 inch (2.05 mm) minimum.
   5. Aluminum Finish: Class I color anodized; finish welded units after fabrication.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

2.04 FINISHES

A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.

B. Color: Dark bronze.

2.05 ACCESSORIES

A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 1-1/2 inch (38 mm) thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.

B. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.

C. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch (1.63 mm) diameter wire, 1/2 inch (13 mm) open weave, diagonal design.

D. Fasteners and Anchors: Galvanized steel.

E. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

F. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Set sill members and sill flashing in continuous bead of sealant.

D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

E. Secure louver frames in openings with concealed fasteners.

3.03 CLEANING

A. Strip protective finish coverings.

B. Clean surfaces and components.

END OF SECTION 08 91 00

SECTION 09 03 00
CONSERVATION TREATMENT OF PERIOD FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum plastering.

B. Cast plaster fabrications.

C. Plaster repair.

1.02 RELATED REQUIREMENTS

A. Section 01 35 91 - Period Treatment Procedures for general historic preservation project requirements.

B. Section 09 91 23 - Interior Painting.

C. Section 09 22 36 - Lath: Metal lath, furring, and accessories for plaster base.

D. Section 09 23 00 - Gypsum Plastering: Plaster mixes.

1.03 REFERENCE STANDARDS

A. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.

B. ASTM C842 - Standard Specification for Application of Interior Gypsum Plaster; 2005 (Reapproved 2021).

C. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittals procedures.

B. Plaster Materials Product Data: Plaster materials, characteristics, and limitations of products.

C. Restorer's qualification statement.

1.05 QUALITY ASSURANCE

A. Cast Plaster Fabrication Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

B. Plasterwork Restorer Qualifications: Company specializing in period plaster restoration with minimum five years of experience.

1. Repair and replacement of plasterwork components shall be performed by experienced plastering specialists who have demonstrated proficiency on historic structures.
2. Experience based solely on new gypsum board, veneer plaster, or gypsum and cement plastering is not acceptable.

1.06 MOCK-UPS

A. Locate where directed.

B. Mock-up may remain as part of the work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original and unopened packaging, with brand names and manufacturer's labels intact and legible.

B. Store materials in dry location, fully protected from weather and direct exposure to sunlight.

1.08 FIELD CONDITIONS

A. Maintain temperature between 50 degrees F (10 degrees C) and 80 degrees F (27 degrees C) for not less than one week prior to applying plaster and continuously after applying plaster.

B. Maintain adequate ventilation to remove excess water while plaster dries.

PART 2 PRODUCTS

2.01 GYPSUM PLASTERING

A. Applications:

1. Flat plaster ceilings.

2. Run-in-place plaster moldings.
3. Ornamental plaster elements.

B. Plaster Mixes: See Section 09 23 00.

C. Plaster Repair Adhesives and Consolidants:
1. Conditioners: Liquid consolidant and conditioner designed to penetrate gypsum coats and substrates.
2. Adhesives: Water-based emulsion formulated to reattach plaster to wood lath.
3. Accessories: Plaster adhesive repair product manufacturer's installation accessories.
a. Clamps: 1-3/4 inch (44 mm) plastic washers.
b. Fasteners: 1-3/4 inch (44 mm) long coarse thread wood screws with 1/8 inch (3 mm) diameter shank.
c. Drill Bits: Carbide-tipped masonry bits, 3/16 inch (4.8 mm) diameter.

D. Lath and Accessories:
1. Wood Lath: Pine, fir, or cedar strips, kiln-dried. Match width and thickness dimensions of existing lath.
2. Gypsum Lath: ASTM C1396/C1396M, standard type.
a. Thickness: 3/8 inch (10 mm).
3. Metal Lath and Accessories: See Section 09 22 36.
4. Fasteners: Nails, staples, or other approved metal supports, of type and size to suit application, compatible with lath and plaster, and capable of rigidly securing lath and accessories in place.

PART 3 EXECUTION

3.01 RESTORERS

A. Acceptable Restorers:
1. Jeff Poree Plastering and Paint LLC.
2. Cypress Building Conservation.
3. Other additional restorers to be approved by Owner.

3.02 PERIOD TREATMENT, GENERAL

A. See Section 01 35 91 for special procedure requirements related to elements and features of historical significance and value.

3.03 EXAMINATION

A. Verify existing conditions are satisfactory before starting work.

B. Plastering Substrates:
1. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify there are no bituminous or water repellent coatings on masonry surface.
2. Concrete: Verify surfaces are flat, honeycomb is filled flush, and surface is ready to receive work of this section. Verify there are no bituminous, water repellent, or form release agents on concrete surfaces that are detrimental to plaster or plaster bond.
3. Lath: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.04 PREPARATION

A. General: Remove and salvage elements and hardware for reinstallation; tag and protect surface-mounted items.

B. Install temporary protection measures.

C. Removal of Existing Damaged Plaster: Remove only portions indicated to be repaired or replaced.
1. Remove soft or crumbled plaster using hand tools.
2. Remove delaminated but otherwise sound plaster and lath using saws or grinders.
3. Remove each coat to extent that will allow blending or keying new work into edges of existing installation.

D. Plastering on Masonry Substrates:
1. Dampen masonry surfaces to reduce excessive suction.

2. Clean surfaces of foreign matter. Thoroughly dampen surfaces before using acid solutions, solvent, or detergents to perform cleaning. Wash surface with clean water.
3. Roughen smooth surfaces.

3.05 INSTALLATION - LATH AND ACCESSORIES

A. Install wood lath to match key spacing of existing lath, but leave keys no narrower than 1/4 inch (6 mm), unless indicated otherwise.

B. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.

C. Coordinate installation of frames plumb and level in opening.

D. Place acoustic sealant at gypsum lath perimeter in accordance with manufacturer's instructions.

3.06 FLAT PLASTER ADHESIVE REPAIR

A. Confirm the substrates to which the plaster will be re-adhered are sound and free of debris and defects affecting proper application of plaster adhesive repair products.

B. Determine the spacing pattern of wood lath to accurately locate injection holes directly over lath to ensure plaster repair adhesives will bond plaster to lath.

C. Injection Holes for Plaster: Drill holes through the surface plaster layer at lath locations and into the void between the plaster and substrate, either lath or masonry, to create injection portholes for plaster repair adhesive products to bond the plaster to the substrate.

D. Conditioner Application: Inject conditioner directly into drilled holes of plaster surfaces onto lath and along crack lines to ensure saturation of the rear surface of loose plaster.
1. Minimize overflow of conditioner onto front of plaster surfaces and surrounding materials.
2. Allow a minimum of 10 minutes and no more than 60 minutes between pretreatment with conditioner and application of adhesive to allow surfaces to absorb conditioner.
3. Remove excess conditioner according to manufacturer's instructions.

E. Adhesive Application: Inject sufficient amount of adhesive into drilled and pretreated holes to ensure the void between the plaster and lath is filled.
1. Avoid overfilling the void or exerting pressure during filling.
2. Immediately remove excess adhesive spillage or overflow. Clean surfaces according to manufacturer's instructions.

F. Clamp Application: Install clamps into holes and cracks within 30 minutes of injecting the adhesive.
1. Secure clamps with screws that penetrate into wood lath.
2. Gently bring loose plaster area back into alignment with original plane.
3. Remove clamps after adhesive has set for time period recommended by manufacturer for project temperature and humidity conditions.

G. Evaluation of Effectiveness of Repair: The work will be considered successful when the following conditions are met:
1. At least 80 percent of each treated area exhibits no hollow sounds when the surface is tapped, and 90 percent of each treated area has limited movement and is stable when surfaces are lightly pressed. Areas with residual hollowness smaller than 144 square inches (0.093 square meters) in size will be acceptable.

3.07 FLAT PLASTERING

A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.

B. Thickness of Plaster including Finish Coat:
1. Over wood lath: 3/4 inch (19 mm).
2. Over metal lath: 5/8 inch (16 mm).
3. Over gypsum lath: 1/2 inch (13 mm).
4. Direct to unit masonry: 5/8 inch (16 mm).

C. Finish Texture: Float to a consistent and smooth finish.

3.08 INTERIOR ORNAMENTAL PLASTERING

A. Run-in-Place Plaster:
1. Form wet plaster in situ and apply to prepared substrate.

2. Run cornices smooth and true using metal template cut to profiles shown on drawings.
3. Perform accurate miters at corners and angles.

B. Cast Plaster Elements:
1. Pour plaster mixture for castings into reusable rubber mold.
2. Allow cast elements to dry in accordance with plaster manufacturer's instructions.
3. Depending on substrate, install using adhesive, galvanized tie wire to metal lath backing, or mechanical fasteners.

C. Finishing:
1. Point joints neatly and sand lightly.

3.09 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION 09 03 00

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Cementitious backing board.

F. Gypsum wallboard.

G. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

E. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

H. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).

I. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

J. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

K. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

L. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

M. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

N. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

O. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

P. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.

Q. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

R. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

S. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019 (Reapproved 2024).

T. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

V. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

W. ASTM E413 - Classification for Rating Sound Insulation; 2022.

X. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

Y. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.

Z. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

AA. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

A. Product Data:
   1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

B. Installer's Qualification Statement.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Sound-Rated: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC as reflected in assemblies indicated on drawings calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.

D. Shaft Walls at Elevator Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Intermittent loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.

E. Fire-Resistance-Rated Assemblies: Provide completed assemblies as indicated in drawings.
   1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
   2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
   3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.

B. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. Steel Construction Systems: www.steelconsystems.com/#sle.
   3. SuperStud Building Products: https://www.buysuperstud.com/.

4. Substitutions: See Section 01 60 00 - Product Requirements.

C. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Ceiling Channels: T-shaped.
   4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
   5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.
      a. Products:
         1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
         2) Similar product by a specified manufacturer..
         3) Substitutions: See Section 01 60 00 - Product Requirements.

D. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
   1. Products:
      a. Same manufacturer as other framing materials.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection and prevent rotation of studs while maintaining structural performance of partition.
   1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100.
   2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot-dipped galvanized coating.
   3. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-resistance rating of the wall assembly.
      a. Products:
         1) ClarkDietrich; MaxTrack Slotted Deflection Track: www.clarkdietrich.com/#sle.
         2) Super Stud Building Products, Inc; Slotted Deflection Track: www.buysuperstud.com/#sle.
         3) Substitutions: See Section 01 60 00 - Product Requirements.

F. Non-structural Framing Accessories:
   1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
   2. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

G. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.
   1. Products:
      a. USG Corporation; Drywall Suspension System: www.usg.com/#sle.
      b. Similar product by specified manufacturer..
      c. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
   3. National Gypsum Company: www.nationalgypsum.com/#sle.
   4. USG Corporation: www.usg.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Glass mat faced gypsum panels, as defined in ASTM C1658/C1658M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.

3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
    b. Mold resistant board is required at all ground floor locations and exterior walls..
4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
5. Thickness:
    a. Vertical Surfaces: 5/8 inch (16 mm).
    b. Ceilings: 5/8 inch (16 mm).
    c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Abuse Resistant Wallboard:
1. Application: within kitchen areas, stairs and corridors..
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Type: Fire-resistance-rated Type X, UL or WH listed.
4. Thickness: 5/8 inch (16 mm).
5. Edges: Tapered.

D. Backing Board For Wet Areas: One of the following products:
1. Application: Horizontal surfaces behind tile in wet areas including countertops and walls behind or within five feet perpendicular to water closets, urinals and lavatories .
2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    a. Thickness: 1/2 inch (13 mm).
    b. Products:
        1) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
        2) Substitutions: See Section 01 60 00 - Product Requirements.
3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
    a. Regular Type: Thickness 1/2 inch (13 mm).
    b. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch (16 mm).
    c. Products:
        1) Georgia-Pacific Gypsum; DensShield Tile Backer: www.gpgypsum.com/#sle.
        2) Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Tile Backer: www.goldbondbuilding.com/#sle.
        3) Substitutions: See Section 01 60 00 - Product Requirements.

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Type: Regular and Type X, in locations indicated.
4. Type X Thickness: 5/8 inch (16 mm).
5. Regular Board Thickness: 5/8 inch (16 mm).
6. Edges: Tapered.
7. Products:
    a. Georgia-Pacific Gypsum; DensArmor Plus: www.gpgypsum.com/#sle.
    b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
    c. Substitutions: See Section 01 60 00 - Product Requirements.

F. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Paper-Faced Products:
    a. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.

b. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond Shaftliner XP: www.goldbondbuilding.com/#sle.
c. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3-5/8 inch (92 mm).

B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
2. Tape Thickness: 1/4 inch (6 mm).

C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

D. Finishing Accessories: ASTM C1047, extruded aluminum alloy (6063 T5) or galvanized steel sheet ASTM A924/A924M G90, unless noted otherwise.
1. Types: As detailed or required for finished appearance.
2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Fiberglass Tape: 2 inch (50 mm) wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
2. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
3. Joint Compound: Setting type, field-mixed.

F. Finishing Compound: Surface coat and primer, takes the place of skim coating.

G. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches (0.84 mm) in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

H. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch (0.84 to 2.84 mm) in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C1007AISI S220 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Install bracing as required at exterior locations to resist wind uplift.

C. Studs: Space studs at 16 inches on center (at 406 mm on center).
1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in

accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.

D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches (100 mm) from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches (600 mm) on center.
   1. Orientation: Vertical.

F. Blocking: Install mechanically fastened steel sheet blocking for support of:
   1. Wall-mounted cabinets.
   2. Plumbing fixtures.
   3. Toilet partitions.
   4. Toilet accessories.
   5. Wall-mounted door hardware.
   6. Where additionally indicated in drawings.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Place one bead continuously on substrate before installation of perimeter framing members.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board parallel to framing, with ends and edges occurring over firm bearing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.

F. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

G. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

H. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
   1. Single-Layer Applications: Screw attachment.
   2. Double-Layer Application: Install base layer using screws or nails. Install face layer using adhesive.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

A. Glass Mat Faced Gypsum Board: Use fiberglass joint tape, embed and finish with setting type joint compound.

B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
   2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction. Fire-resistance-rated ceilings above finished ceilings, whether or not accessible in the completed construction.

D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION 09 21 16

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SECTION 09 22 36
LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lath for gypsum plaster.

B. Furring for metal lath.

C. Metal ceiling framing.

1.02 RELATED REQUIREMENTS

A. Section 09 22 16 - Non-Structural Metal Framing.

B. Section 09 23 00 - Gypsum Plastering.

1.03 REFERENCE STANDARDS

A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

C. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.

D. ASTM C847 - Standard Specification for Metal Lath; 2018 (Reapproved 2024).

E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

G. ASTM C1861 - Standard Specification for Lathing and Furring Accessories, and Fasteners, for Interior and Exterior Portland Cement-Based Plaster; 2023a.

H. ASTM F1667/F1667M - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples; 2021a.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Lath and Accessories:
   1. Alabama Metal Industries Corporation; Self-Furred Diamond Mesh Lath: www.amico-lath.com/#sle.
   2. CEMCO: www.cemcosteel.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING AND LATH ASSEMBLIES

A. Provide completed assemblies with the following characteristics:
   1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs (445 N).
   2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.

2.03 LATH

A. Diamond Mesh Metal Lath: ASTM C847, galvanized; self-furring.
   1. Weight: To suit application and as specified in ASTM C841 or ASTM C1063 for framing spacing.
   2. Weight: 2.5 lb/sq yd (1.4 kg/sq m).
   3. Backed with treated paper.

B. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, and maximum possible lengths.
   1. Material: Formed sheet steel with rust inhibitive primer, expanded metal flanges.
   2. Corner Beads: Radiused corners.
   3. Expansion Joints: Accordion profile with factory-installed protective tape, 2 inch (50 mm) wide flanges.
   4. Base Screeds: Bevelled edges, perforated.
   5. Control Joints: Accordion profile with factory-installed protective tape, 2 inch (50 mm) flanges.

2.04 FURRING ACCESSORIES

A. Strap Hangers: Comply with ASTM C1861.
   1. Description: Flat steel straps fabricated for through-bolt attachments.
   2. Applications:
      a. Interior ceilings; used to suspend plaster assemblies from structure above.

B. U-Channel Furring: Comply with ASTM C1861.
   1. Description: U-shaped, cold-formed furring units.
   2. Applications:
      a. Interior ceilings; used as furring accessories in suspended plaster assemblies.
   3. Web Depth: 2 inches (51 mm).
   4. Flange Dimension: 1/2 inch (13 mm).
   5. Material: Steel sheet, galvanized or galvannealed; comply with ASTM A653/A653M.
   6. Minimum Yield Strength: 33 ksi (228 MPa).

C. Z-Furring: Comply with ASTM C1861.
   1. Description: Z-shaped, cold-formed, furring accessories.
   2. Applications:
      a. Interior framed walls; used for supporting plaster assemblies.
   3. Fabricate from galvanized steel sheet in accordance with ASTM A653/A653M.
   4. Depth: 1-1/2 inches (38 mm).
   5. Minimum Yield Strength: 33 ksi (228 MPa).
   6. Structural Steel Thickness: 20 gauge, 0.0312 inch (0.792 mm).
   7. Protective Coating for Interior Applications:
      a. Zinc Coating Thickness: G40 (Z120), minimum.

D. Tie Wire: Comply with ASTM C1861.
   1. Applications:
      a. Interior applications; used for attaching lathing and furring accessories.
   2. Carbon Steel Wire: ASTM A641/A641M; annealed, Class 1, zinc-coated galvanized.
      a. Wire Diameter: 18 gauge, 0.0475 inch (1.21 mm) uncoated.

E. Hanger Wire: Comply with ASTM C1861.
   1. Applications: Interior ceilings; used for hanging lath and plaster ceiling assemblies.
   2. Carbon Steel Wire: ASTM A641/A641M; annealed, Class 1, zinc-coated galvanized.
      a. Wire Diameter: 8 gauge, 0.1620 inch (4.12 mm), uncoated.

2.05 ACCESSORIES

A. Nails and Staples: Comply with ASTM C1861 and ASTM F1667/F1667M.
   1. Applications: Fastening into concrete joists.
   2. Comply with ASTM C1861 for nail type and embedment depth.

B. Screws: Comply with ASTM C1861 and:
   1. ASTM C1002 for fastening metal plaster bases to steel studs less than 0.033 inch (0.84 mm) thick.
   2. ASTM C954 for fastening metal plaster bases to steel studs from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrates are ready to receive work and conditions are suitable for application.

C. Do not begin until unacceptable conditions have been corrected.

D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.

3.03 CEILING AND SOFFIT FRAMING INSTALLATION

A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.

B. Install furring independent of walls, columns, and above-ceiling work.

C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.

D. Space main carrying channels at maximum 72 inch (1800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.

E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.

F. Install furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.

3.04 LATH INSTALLATION

A. Apply lath taut, with long dimension perpendicular to supports.

B. Lap or nest ends of metal lath in accordance with ASTM C841.

C. Secure end laps with tie wire where they occur between supports.

D. Attach metal lath to metal supports using tie wire at maximum 6 inches (150 mm) on center.

E. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches (75 mm) from corner to form the angle reinforcement; fasten at perimeter edges only.

F. Place corner bead at external wall corners; fasten at outer edges of lath only.

G. Place base screeds at termination of plaster areas; secure rigidly in place.

H. Place lath vertically above each top corner and each side of door frames to 6 inches (150 mm) above ceiling line.

I. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

J. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.05 TOLERANCES

A. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from True Position: 1/8 inch (3 mm).

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SECTION 09 23 00
GYPSUM PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum plastering.

B. Gypsum lath.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

B. Section 09 21 16 - Gypsum Board Assemblies: Metal stud framing and furring for plaster.

C. Section 09 22 36 - Lath: Metal lath, furring, and accessories for plaster base.

1.03 REFERENCE STANDARDS

A. ASTM C28/C28M - Standard Specification for Gypsum Plasters; 2010 (Reapproved 2020).

B. ASTM C35 - Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster; 2001 (Reapproved 2019).

C. ASTM C206 - Standard Specification for Finishing Hydrated Lime; 2014 (Reapproved 2022).

D. ASTM C631 - Standard Specification for Bonding Compounds for Interior Gypsum Plastering; 2009 (Reapproved 2020).

E. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.

F. ASTM C842 - Standard Specification for Application of Interior Gypsum Plaster; 2005 (Reapproved 2021).

G. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittals procedures.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain minimum ambient temperature of 50 degrees F (10 degrees C) during and after installation of plaster.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Gypsum Plaster:
   1. National Gypsum Company: www.nationalgypsum.com/#sle.
   2. USG: www.usg.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PLASTER MATERIALS

A. Gypsum Neat Plaster: ASTM C28/C28M; fibered.

B. Ready-Mixed Gypsum Plaster: ASTM C28/C28M; mill-mixed type, requiring only the addition of water.

C. Lime: ASTM C206, Type S; special finishing hydrated lime.

D. Aggregate for Base Coats: ASTM C35; sand and lightweight aggregates.

E. Aggregate for Finish Coats: As specified in ASTM C842.

F. Water: Clean, fresh, potable and free of mineral or organic matter that could adversely affect plaster.

G. Bonding Agent: ASTM C631 Type recommended for bonding plaster to monolithic concrete surfaces.

2.03 LATH AND ACCESSORIES

A. Metal Lath and Accessories: As specified in Section 09 22 36.

B. Gypsum Lath: ASTM C1396/C1396M, standard type.
   1. Thickness: 3/8 inch (10 mm).

C. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, maximum possible lengths.

2.04 PLASTER MIXES

A. Over Gypsum Lath: Two-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions.

B. Over Metal Lath: Three-coat application, ready-mixed plaster, mixed and proportioned in accordance with ASTM C842 and manufacturer's instructions.

C. Ready-Mixed Plaster Materials: Mix in accordance with manufacturer's instructions.

D. Finish Coat for Floated Finish: Lime putty with gypsum gauging plaster, mixed and proportioned in accordance with ASTM C842.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing conditions are satisfactory before starting work.

B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.

C. Concrete: Verify surfaces are flat, honeycomb is filled flush, and surface is ready to receive work of this section. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to plaster or plaster bond.

D. Grounds and Blocking: Verify items within walls for other sections of work have been installed.

E. Gypsum Lath and Accessories: Verify substrate is flat and surface is ready to receive work of this section. Verify joint and surface perimeter accessories are in place.

F. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

3.02 INSTALLATION - GYPSUM LATH AND ACCESSORIES

A. Install gypsum lath in accordance with ASTM C841.

B. Install gypsum lath perpendicular to framing members, with lath face exposed. Stagger end joint of alternate courses. Butt joints tight. Maximum gap allowed: 1/8 inch (3 mm).

C. Place corner reinforcement diagonally over gypsum lath and across corner immediately above and below openings. Secure to gypsum lath only.

D. Continuously reinforce internal angles with corner mesh, return 3 inches (75 mm) from corner to form the angle reinforcement; fasten at perimeter edges only.

E. Place corner bead at external wall corners; fasten at outer edges of lath only.

F. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

G. Place 4 inch (100 mm) wide strips of strip mesh centered over junctions of dissimilar backing materials. Secure rigidly in place.

H. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.

3.03 PLASTERING

A. Apply gypsum plaster in accordance with ASTM C842 and manufacturer's instructions.

B. Thickness of Plaster including Finish Coat:
   1. Over metal lath: 5/8 inch (16 mm).
   2. Over gypsum lath: 1/2 inch (13 mm).
   3. Direct to unit masonry: 5/8 inch (16 mm).

C. Finish Texture: Float to a consistent and smooth finish.

3.04 TOLERANCES

A. Maximum Variation from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION 09 23 00

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SECTION 09 30 00
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Tile for countertop backsplashes.

D. Coated glass mat backer board as tile substrate.

E. Stone thresholds.

F. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

B. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

B. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.

C. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.

D. ANSI A118.5 - American National Standard Specifications for Chemical Resistant Furan Mortars and Grouts for Tile Installation; 1999 (Reaffirmed 2021).

E. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

F. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.

G. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2024).

H. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

I. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.

J. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products; 2018 (Reapproved 2023).

K. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.

L. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches (457 by 457 mm) in size illustrating pattern, color variations, and grout joint size variations.

D. Installer's qualification statement.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Tile: 1 percent of each size, color, and surface finish combination, but not less than box of each type.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.06 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Construct tile mock-up incorporating components specified for location.
   1. Minimum size of mock-up is 4 ft by 4 ft.
   2. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile:
   1. Dal-Tile Corporation: www.daltile.com/#sle.
   2. Metropolitan Ceramics: www.metroceramics.com/#sle.
   3. Bedrosians: www.bedrosians.com/#sle.
   4. Portabello America: www.portobelloamerica.com/#sle.
   5. Concept Surfaces: www.conceptsurfaces.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

B. Setting Materials:
   1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
   2. Custom Building Products: www.custombuildingproducts.com/#sle.
   3. LATICRETE International, Inc: www.laticrete.com/#sle.
   4. Mapei Corporation: www.mapei.com/#sle.
   5. Schluter-Systems: www.schluter.com/#sle.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

C. Grout:
   1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
   2. Custom Building Products: www.custombuildingproducts.com/#sle.
   3. LATICRETE International, Inc: www.laticrete.com/#sle.
   4. Mapei Corporation: www.mapei.com/#sle.
   5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Floor Tile: Provide tile for flooring applications with minimum wet Dynamic Coefficient of Friction (DCOF) of 0.42 when tested in accordance with ANSI A326.3.

2.03 TILE

A. Marble Mosaic Tile: ANSI A137.1 standard grade.
   1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.

2. Size: As indicated on drawings.
3. Shape: Rectangle.
4. Edges: Square.

B. Glazed Wall Tile: ANSI A137.1 standard grade.
1. Size: As indicated on drawings.
2. Edges: Square.
3. Surface Finish: High gloss.
4. Color: As indicated on drawings.
5. Trim Units: Matching bead shapes in sizes coordinated with field tile.

C. Quarry Tile: ANSI A137.1 standard grade.
1. Moisture Absorption: Over 3.0 but not more than 5.0 percent as tested in accordance with ASTM C373.
2. Size: 6 by 6 inch (152 by 152 mm), nominal.
3. Thickness: 1/2 inch (12.7 mm), nominal.
4. Surface Finish: Unglazed.
5. Color(s): As indicated.
6. Trim Units: Matching bullnose and cove base shapes in sizes coordinated with field tile.

D. Gauged Porcelain Tiles and Panels/Slabs: ANSI A137.3 standard grade.
1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
2. Size: As indicated on drawings.
3. Thickness: 3/8 inch (9.5 mm).
4. Edges: Rectified.
5. Surface Finish: Matte.
6. Color: As indicated on drawings.

2.04 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
1. Applications:
a. Open edges of wall tile where no tile trim indicated: Schluter J100 EB.
b. Base of tile wall: Schluter Dilex-AHKA-10
2. Products:
a. Schluter-Systems; Schiene: www.schluter.com/#sle.
b. Substitutions: See Section 01 60 00 - Product Requirements.

B. Thresholds: 2 inches (51 mm) wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
1. Thickness:
a. 5/8 inch (15.9 mm) where adjacent to tile.
b. 3/8 inch (9.5 mm) where used stand-alone.
2. Material: Granite, black, polished finish.
3. Applications:
a. At doorways where tile terminates.
b. Where indicated in drawings.

2.05 SETTING MATERIALS

A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
1. Products:
a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
c. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex: www.merkrete.com/#sle.
d. Substitutions: See Section 01 60 00 - Product Requirements.

2.06 GROUTS

A. Standard Grout: ANSI A118.6 standard cement grout.

1. Use sanded grout for joints 1/8 inch (3.2 mm) wide and larger; use unsanded grout for joints less than 1/8 inch (3.2 mm) wide.
2. Color: As indicated on drawings.
3. Products:
   a. Custom Building Products; Polyblend Non-Sanded Grout: www.custombuildingproducts.com/#sle.
   b. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
   c. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Grout: www.merkrete.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
1. Applications: Use this type of grout where indicated and where no other type of grout is indicated..
2. Color: As selected by Architect from manufacturer's full line.
3. Products:
   a. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
   b. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
   c. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
   d. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
   e. Substitutions: See Section 01 60 00 - Product Requirements.

C. Furan Grout: ANSI A118.5 chemical resistant furan resin grout.
1. Color: As indicated on drawings.
2. Products:
   a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
   b. LATICRETE International, Inc; LATICRETE SPECTRALOCK 2000 IG: www.laticrete.com/#sle.
   c. Mapei Corporation; Kerapoxy IEG CQ: www.mapei.com/#sle.
   d. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 MAINTENANCE MATERIALS

A. Tile Sealant: Gunnable, silicone, siliconized acrylic, modified silane polymer, or urethane sealant; moisture- and mildew-resistant type.
1. Applications: Between tile and plumbing fixtures.

B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
1. Composition: Water-based colorless silicone.

C. Grout Release: Temporary, water-soluble pre-grout coating.

2.08 ACCESSORY MATERIALS

A. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
1. Crack Resistance: No failure at 1/16-inch (1.6 mm) gap, minimum; comply with ANSI A118.12.
2. Bonded Sheet Membrane Type:
   a. Material: High-density polyethylene membrane with a grid structure of 1/2 inch x 1/2 inch (12 mm x 12 mm) square cavities, each cut back in a dovetail configuration, and a polypropylene anchoring fleece laminated to its underside.

B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
1. Standard Type: 1/2 inch (12.7 mm) thick.

C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.

B. Verify wall surfaces are smooth and flat within tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

3.02 PREPARATION

A. Vacuum clean surfaces and damp clean.

B. Seal substrate surface cracks with filler.

C. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to feather edge.

3.03 INSTALLATION - GENERAL

A. Lay tile to pattern indicated on drawings. Do not interrupt tile pattern through openings.

B. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

C. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

D. Form internal angles square and external angles bullnosed.

E. Install non-ceramic trim in accordance with manufacturer's instructions.

F. Install thresholds where indicated on drawings.

G. Sound tile after setting. Replace hollow sounding units.

H. Keep control and expansion joints free of mortar, grout, and adhesive.

I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

J. Grout tile joints unless otherwise indicated on drawings. Use standard grout unless otherwise indicated on drawings.

K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with epoxy grout.
   1. Use uncoupling membrane under tile unless other underlayment is indicated on drawings.
   2. Where waterproofing membrane is indicated on drawings, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout, on ground.
   3. Where epoxy bond coat and grout are indicated on drawings, install in accordance with TCNA (HB) Method F131.
   4. Where epoxy or furan grout is indicated on drawings, but not epoxy or furan bond coat, install in accordance with TCNA (HB) Method F115.

B. Over wood substrates, install in accordance with TCNA (HB) Method F142, with epoxy grout.
   1. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F143.

C. Over wood substrates with backer board underlayment, install in accordance with TCNA (HB) Method F144, for cementitious backer boards, with standard grout.

D. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

E. Location: Restrooms.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated on drawings.
   1. Where epoxy bond coat and grout are indicated on drawings, install in accordance with TCNA (HB) Method F132, bonded.

B. Cleavage Membrane: Lap edges and ends.

C. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.

D. Mortar Bed Thickness: Maximum 3/4 inch (19 mm), unless otherwise indicated, slope to drain 1/8 inch per foot.

E. Location: Kitchen, where indicated in drawings.

3.06 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C, using membrane at toilet rooms, kitchens, locker rooms, and _____.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.07 CLEANING

A. Clean tile and grout surfaces.

3.08 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

3.09 SCHEDULES

A. Tile:
   1. TIL-01: Quarry Floor Tile as indicated in drawings.
   2. TIL-02: Quarry Floor Tile as indicated in drawings.
   3. TIL-03: Ceramic Wall Tile as indicated in drawings.
   4. TIL-04: Marble Mosaic Floor Tile as indicated in drawings.
   5. TIL-05: Not used.
   6. TIL-06: Ceramic Wall Tile as indicated in drawings.
   7. TIL-07: See Section 04 26 16.
   8. TIL-08: Ceramic Wall Tile as indicated in drawings.
   9. TIL-09: Ceramic Wall Tile as indicated in drawings.
   10. TIL-10: Not used.
   11. TIL-11: Ceramic Wall Tile as indicated in drawings.
   12. TIL-12: Porcelain Floor Tile as indicated in drawings.

END OF SECTION 09 30 00

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples illustrating material and finish of acoustical units.

D. Samples: Submit two samples each of suspension system main runner, cross runner, and perimeter molding.

E. Manufacturer's Qualification Statement.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F (16 degrees C), and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Tiles/Panels:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. CertainTeed Corporation: www.certainteed.com/#sle.
   3. USG Corporation: www.usg.com/ceilings/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTICAL UNITS

A. Acoustical Panels, Type A: Mineral fiber with membrane-faced overlay, with the following characteristics:
   1. Application(s): Future Work - Office areas.
   2. Classification: ASTM E1264 Type IV.
      a. Form: 2, water felted.

b. Pattern: "E" - lightly textured.
3. Size: 24 by 48 inch (610 by 1219 mm).
4. Thickness: 3/4 inch (19 mm).
5. Panel Edge: Tegular.
6. Color: White.
7. Suspension System: Exposed grid, 9/16 inches
8. Products:
   a. Armstrong World Industries, Inc; Ultima: www.armstrongceilings.com/#sle.
   b. USG Corporation; Mars Acoustical Panels: www.usg.com/ceilings/#sle.

B. Acoustical Panels, Type B: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Application(s): Kitchen Vestibule and Future Work - Office areas.
2. Classification: ASTM E1264 Type IV.
   a. Form: 2, water felted.
3. Classification: ASTM E1264 Type IV.
   a. Form: 2, water felted.
   b. Pattern: "E" - lightly textured.
4. Size: 24 by 24 inches (610 by 610 mm).
5. Thickness: 3/4 inch (19 mm).
6. Panel Edge: Tegular.
7. Color: As indicated on drawings.
8. Suspension System: Exposed grid, 9/16 inches
9. Products:
   a. Armstrong World Industries, Inc; Ultima: www.armstrongceilings.com/#sle.
   b. USG Corporation; Mars Acoustical Panels: www.usg.com/ceilings/#sle.

C. Acoustical Panels, Type K: Mineral fiber with scrubbable finish, with the following characteristics:
1. Application(s): Kitchen areas.
2. Classification: ASTM E1264 Type IX.
   a. Form: 2, water felted.
   b. Pattern: "G" - smooth.
3. Size: 24 by 48 inch (610 by 1219 mm).
4. Thickness: 5/8 inches (16 mm).
5. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
6. Panel Edge: Square.
7. Color: White.
8. Suspension System: Exposed grid. 15/16 inches.
9. Products:
   a. Armstrong Ceiling; Kitchen Zone: www.armstrongceilings.com/kitchenzone
   b. USG Corporation; Kitchen Lay-In Panels: www.usg.com/ceilings/#sle.

2.03 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
1. Materials:
   a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
2. Profile: Tee; 15/16 inch (24 mm) face width.
3. Finish: Baked enamel.

2.04 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch (2 mm) galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

1. Size: As required for installation conditions.
2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
1. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.05 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.06 SCHEDULE

A. Schedule of Acoustical Panels:
1. ACP-01: Type K.
2. ACP-02: Type A.
3. ACP-03: Type B, White.

4. ACP-04: Type B, Black
5. ACP-05: Section 09 83 00.

END OF SECTION 09 51 00

SECTION 09 54 21
METAL PAN CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal pan ceilings.

B. Suspended metal support system and perimeter trim.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2020.

E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work of this section with installation of mechanical and electrical components and with other construction activities affected by work of this section.

B. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Furnish for component profiles.

C. Shop Drawings: Indicate reflected ceiling plan.

D. Samples: Submit two samples showing color and finish of components exposed to view.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements for additional provisions.
   2. Extra Metal Panels: Four, standard dimensions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept factory-finished products on site in manufacturer's unopened factory packaging; reject opened packages.

B. Protect factory-finished products from damage by storing in manufacturer's unopened factory packaging in dry storage area.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Pan Ceilings:
   1. Armstrong World Industries, Inc; MetalWorks for DesignFlex: www.armstrongceilings.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Suspension Systems:
   1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index of 25, smoke developed index of 450, when tested in accordance with ASTM E84.

2.03 METAL PAN CEILING ASSEMBLIES

A. Metal Pan Ceiling System: Panels, suspension members, trim, and accessories as required to provide a complete system.
   1. Exposed fasteners are not permitted.

B. Lay-in Panels: Metal-faced, prefinished panels with square edge for lay-in installation allowing every panel access to ceiling plenum.
   1. Classification: ASTM E1264, Class A, unperforated, aluminum formed sheet.
   2. Panel Size: As indicated on drawings.
   3. Finish: Painted.
      a. Color: As indicated on drawings.
   4. Suspension System: Exposed grid.

2.04 SUSPENSION SYSTEM

A. Metal Suspension Systems - General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

B. Exposed Suspension System: Stainless steel grid and cap.
   1. Structural Classification: Light-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 9/16-inch (14 mm) face width.
   3. Finish: Manufacturer's standard.
   4. Color: To match metal pans.

2.05 ACCESSORIES

A. End Caps: Formed metal; same color and finish as sight-exposed surfaces of metal panels.

B. Suspension Wire: Size and type as required for application and ceiling system flatness requirement specified.
   1. Concealed Suspension:
      a. Suspension Wire: Steel, annealed, galvanized finish, 12 gauge, 0.0808-inch (2.05 mm) diameter.

C. Touch-Up Paint for Exposed Surfaces: Type and color to match pans and suspension system grid and trim elements.

2.06 FABRICATION

A. Shop cut metal panels to accommodate mechanical and electrical items.

B. Factory-form internal and external corners of same material, thickness, finish, and profile to match exposed metal panels; back brace internal corners.

C. Fabricate components to allow access to ceiling plenum as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

C. Verify that field measurements are as indicated on shop drawings.

D. Start of installation constitutes acceptance of project conditions.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Install after major above-ceiling work is complete.

3.03 INSTALLATION - SUSPENSION SYSTEM:

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented by this section.

B. Install hangers and inserts coordinated with overhead work. Provide additional hangers and supports as required.

C. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

D. Suspension System, Nonseismic: Hang suspension system independent of walls, columns, ducts, pipes, and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

E. Where ducts, facility services, or equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

G. Support fixture loads using supplementary hangers located within 6 inches (152 mm) of each corner, or support components independently.

H. Do not eccentrically load system or induce rotation of runners.

I. Edge Moldings: Install at intersection of ceiling and vertical surfaces and penetrations, using components of maximum length, set level.
   1. Use longest practical lengths.

3.04 INSTALLATION - METAL PANS

A. Install panels and other system components in accordance with manufacturer's instructions.

B. Butt interior end joints tight.

C. Provide expansion joints to accommodate plus or minus 1 inch (25 mm) movement and maintain visual closure.

D. Install edge moldings at junctions with other finishes and at vertical surfaces; use maximum piece lengths.

E. Install end caps at sight-exposed ends of panels.

F. Exercise care when site cutting sight-exposed finished components to ensure surface finish is not defaced.

3.05 INSTALLATION OF TRANSITION TRIM

A. After the grids are installed, for each grid end that meets the transition trim, insert one tee attachment clip into the lower and upper bosses and secure the set screw. Leave enough tension for adjustment.

B. Secure a tee attachment clip to each grid member that will connect to the transition trim. Install one framing screw into the center of the slotted screw hole. Leave enough tension so the attachment clip can be adjusted if needed. Follow manufacturer's instructions when aligning the attachment clip.

C. Install the splice plates by sliding them into the bosses at the end of each transition trim joint. Loosely tighten the set screws and align the system square and true.

3.06 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

C. Maximum Variation From Dimensioned Position: 1/4 inch (6 mm).

3.07 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Clean surfaces.

C. Replace damaged or abraded components.

3.08 SCHEDULE

A. SSC-01: Metal Pan Ceiling Assembly.

END OF SECTION 09 54 21

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SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Resilient stair accessories.

D. Installation accessories.

1.02 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2018).

D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

E. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015 (Reapproved 2020).

F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2019.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.

E. Verification Samples: Submit two full-size samples, illustrating color and pattern for each resilient flooring product specified.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Flooring Material: 135 square feet (12.6 square meters) of each type and color.
   3. Extra Wall Base: 120 linear feet (36.6 linear meters) of each type and color.
   4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

C. Installer Qualifications for Sheet Flooring:
   1. Utilize Protect-All factory trained installers provided by local distributor.
   2. Manufacturer provides a limited product warranty against manufacturing defects.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).

D. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Composition Tile: Homogeneous, with color extending throughout thickness.
   1. Manufacturers:
      a. Armstrong Flooring, Inc; Standard Execelon Imperial Texture: www.armstrongflooring.com/#sle.
      b. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F1066, of Class corresponding to type specified.
   3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
   4. Size: 12 by 12 inch (305 by 305 mm).
   5. Thickness: 0.125 inch (3.2 mm).
   6. Color: As selected from manufacturer's full range to match existing.

2.02 STAIR COVERING

A. Stair Treads: Rubber; full width of stair tread in one piece.
   1. Manufacturers:
      a. Roppe Corporation; Rubber Stair Treads: www.roppe.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
   3. Nominal Thickness: 0.1875 inch (4.75 mm).
   4. Nosing: Square.
   5. Texture: Smooth.
   6. Color: Black.
   7. Products:
      a. Roppe Rubber Stair Tread #60 Heavy Duty Smooth Design

B. Stair Risers: Full height and width of riser in one piece, matching treads in material and color.
   1. Manufacturers:
      a. Roppe Corp: www.roppe.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Thickness: 0.10 inch (2.54 mm).
   3. Configuration: Similarly shaped to wall base.
   4. Products:
      a. Roppe Rubber Stair Tread.

2.03 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
   1. Manufacturers:
      a. Johnsonite, a Tarkett Company: www.johnsonite.com/#sle.
      b. Roppe Corp: www.roppe.com/#sle.
      c. Substitutions: See Section 01 60 00 - Product Requirements.
   2. Height: 2-1/2 inch (62 mm).
   3. Thickness: 0.125 inch (3.2 mm).
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: As indicated on drawings.

7. Accessories: Premolded external corners and internal corners.
8. Products:
    a. Roppe Pinnacle Rubber Wall Base.

2.04 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

C. Moldings, Transition and Edge Strips: Same material as flooring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
    1. Test as Follows:
        a. Alkalinity (pH): ASTM F710.
        b. Internal Relative Humidity: ASTM F2170.
    2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is fully cured.

C. Clean substrate.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Adhesive-Applied Installation:
    1. Spread only enough adhesive to permit installation of materials before initial set.
    2. Fit joints and butt seams tightly.
    3. Set flooring in place, press with heavy roller to attain full adhesion.

D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.

E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install square tile to Monolithic pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

3.05 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.

B. Install base on solid backing. Bond tightly to wall and floor surfaces.

C. Scribe and fit to door frames and other interruptions.

3.06 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread.

B. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.08 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.09 SCHEDULE

A. Floor Tile:
   1. VCT-01: Vinyl Composition Tile; Where indicated on drawings

B. Stair Covering:
   1. RBT-01: Install on existing mezzanine stairs.

C. Wall Base:
   1. RB-01: Where indicated on drawings.
   2. RB-02: Where indicated on drawings.

END OF SECTION 09 65 00

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, loose laid with edges and control grid adhered.

1.02 REFERENCE STANDARDS

A. CRI 104 - Standard for Installation of Commercial Carpet; 2015.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Tile Carpeting:
   1. Shaw Contract: www.shawcontract.com/#sle.

2.02 MATERIALS

A. Tile Carpeting: Tufted, manufactured in one color dye lot.
   1. Product: Stillness Tile from Grounded Spaces Collection manufactured by Shaw Contract.
   2. Tile Size: 24 by 24 (610 by 610 mm), nominal.
   3. Color: As indicated on drawings.
   4. Pattern: As indicated on drawings.
   5. Dye Method: 100% Solution Dyed.
   6. Construction: Multi-Level Pattern Loop
   7. Backing: Ecoworx Tile
   8. Pile Weight: 16 oz/sq yd (542.5 gm/sq m).

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Rubber, color as selected by Architect.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.

B. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

3.05 SCHEDULE

A. Carpet Tile:
   1. CPT-01: As indicated on drawings.
   2. CPT-02: As indicated on drawings.

END OF SECTION 09 68 13

SECTION 09 83 00
ACOUSTIC FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Acoustical ceiling panels.

1.02 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023, with Editorial Revision (2024).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets for products specified.

C. Samples: Submit two samples indicating colors for selection.

D. Manufacturer's qualification statement.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Materials: 5 percent of each color and pattern of ceiling panel, of various sizes to match installed panels; store where directed.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Store and handle materials according to manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not apply acoustical finishes when surface and ambient temperatures are outside the temperature ranges required by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustical Ceiling Panels:
   1. Fabric-wrapped panel: ATS Acoustic Panels with Guilford of Maine Fabric.
   2. Polyester Panels: Acoustical Surfaces, Inc, Poly Max.

2.02 ACOUSTIC PANELS

A. General:
   1. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Acoustic Panels.
   1. Minimum Noise Reduction Coefficient (NRC) of 0.70 when tested in accordance with ASTM C423 and ASTM E795.
   2. Surface Burning Characteristics of Acoustical Ceiling Tile: Flame Spread Index of 25, maximum; Smoke Developed Index of 250, maximum; when tested in accordance with ASTM E84.
   3. Color: As indicated on drawings.
   4. Anchors for fabric-wrapped panels: Manufacturer's standard concealed anchors.
   5. Anchors for polyester panels: RotoFast Snap-On Anchors.

C. Accessory Materials: Provide primers, sealers, cleaning agents, and clean up materials as required for completion of acoustic panels.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of acoustic finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

3.02 APPLICATION

A. Acoustic Coatings: Apply in accordance with manufacturer's written instructions.
   1. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
   2. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

3.03 PROTECTION

A. Protect finishes from subsequent construction operations.

B. Touch-up damaged finishes.

3.04 SCHEDULE

A. ACP-05: Either fabric-wrapped or polyester acoustical panel.

END OF SECTION 09 83 00

SECTION 09 91 13
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of new and existing steel items including, but not limited to, existing steel windows, handrails and items attached to building, within scope of work.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Non-metallic roofing and flashing.
   6. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, zinc, and lead.
   7. Marble, granite, slate, and other natural stones.
   8. Floors, unless specifically indicated.
   9. Concrete.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.
   12. Mill aluminum.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.

B. Section 09 96 00 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

C. SSPC-SP 2 - Hand Tool Cleaning; 2024.

D. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.
   2. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.
   3. Label each container with color in addition to the manufacturer's label.

1.05 MOCK-UP

A. Locate where directed by Architect.

B. Mock-up may remain as part of the work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal and galvanized metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
      a. Products:
         1) Sherwin-Williams DTM.
         2) Substitutions: Section 01 60 00 - Product Requirements.
   3. Top Coat Sheen:
      a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
   4. Primer: As specified under "PRIMERS" below.
   5. Topcoat for Metal: Sherwin Williams Pro Industrial DTM Acrylic Coating.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Water Based Primer for Galvanized Metal; MPI #134.
      a. Products:
         1) Sherwin-Williams DTM Primer/Finish (MPI #134)
         2) Substitutions: Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.
   3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi (4,140 to 10,350 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.

G. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

3.06 SCHEDULE - PAINT SYSTEMS

A. Exterior Paint Systems locations are defined on on drawings.

B. Finish new and existing steel surfaces exposed to view.
   1. E-OP, semi-gloss.

END OF SECTION 09 91 13

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Prime surfaces to receive wall coverings.
   3. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. In finished areas, paint shop-primed items.
      c. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      d. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
   10. Glass.
   11. Acoustical materials, unless specifically indicated.
   12. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Shop-primed items.

B. Section 09 91 13 - Exterior Painting.

C. Section 09 96 00 - High-Performance Coatings.

1.03 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

C. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

D. SSPC-SP 2 - Hand Tool Cleaning; 2024.

E. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

1.04 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").

2. MPI product number (e.g., MPI #47).
3. Cross-reference to specified paint system products to be used in project; include description of each system.

B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
1. Where sheen is specified, submit samples in only that sheen.
2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Label each container with color in addition to the manufacturer's label.

1.05 MOCK-UP

A. Locate where directed by Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:
1. Base Manufacturer: Benjamin Moore: www.benjaminmoore.com/#sle..
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, wood, and plaster.

1. Two top coats and one coat primer.
2. Top Coat(s): Interior Latex; MPI #43, 44, 52, 53, 54, or 114.
    a. Products:
        1) Benjamin Moore Super Hide Interior Latex, Low Sheen.
        2) Benjamin Moore Super Hide Interior Latex, Flat.
        3) Benjamin Moore Super Hide Interior Latex, Semi-Gloss.
        4) Benjamin Moore Super Hide Interior Latex, Eggshell.
        5) Benjamin Moore Regal Select Interior Latex, Gloss.
        6) Sherwin-Williams ProMar 200 HP Series, Low Gloss Eg-Shel. (MPI #44)
        7) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
        8) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
        9) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eg-Shel. (MPI #52)
        10) Sherwin-Williams Emerald Interior Latex, Gloss. (MPI #114)
3. Top Coat Sheen:
    a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
    b. Eggshell: MPI gloss level 3; use this sheen at walls and all concrete, metal and masonry surfaces to be painted.
    c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
    d. Gloss: MPI gloss level 6; use this sheen where indicated.
4. Primer: As recommended by top coat manufacturer for specific substrate.
5. At insulation-covered substrates, add fungicidal agent to render insulation mildew proof.

B. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
    a. Products:
        1) Benjamin Moore Corotech Acrylic DTM Enamel, Semi-Gloss.
        2) Sherwin-Williams Pro Industrial Acrylic Coating, Semi-Gloss. (MPI #141)
3. Top Coat Sheen:
    a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Plaster and Stucco: 12 percent.
3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Concrete:

G. Masonry:

H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

I. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high-alkali surfaces.

J. Galvanized Surfaces:
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   2. Prepare surface according to SSPC-SP 2.

K. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

L. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

M. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with tinted primer.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

G. Sand wood and metal surfaces lightly between coats to achieve required finish.

H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 91 23

SECTION 09 93 00
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of stains and transparent finishes.

1.02 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category.

C. Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on actual wood substrate to be finished.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide finishes from the same manufacturer to the greatest extent possible.

B. Transparent Finishes:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

C. Stains:
   1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
   1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each finish material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: To be selected from manufacturer's full range of available colors.
   1. Selection to be made by Architect after award of contract.

2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood - Tri Vertical Surfaces:
   1. Two coat(s) stain, where indicated.
   2. Three coat(s) varnish.
   3. Stain: Semi-Transparent Stain for Wood, Solvent Based.
      a. Product:
         1) Sherwin Williams; Wood Classics Interior Oil Stain A-49 series.
         2) Substitutions: Section 01 60 00 - Product Requirements.
   4. Top Coat(s): Polyurethane Varnish, Water-Based Oil Modified.
      a. Products:
         1) Sherwin Williams; Minwax Water-Based Oil-Modified Polyurethane.
         2) Substitutions: Section 01 60 00 - Product Requirements.
   5. Top Coat(s): Polyurethane Varnish, High Build.
      a. Product:
   6. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen at wall base and other trim.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood surfaces lightly between coats to achieve required finish.

E. Reinstall items removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

END OF SECTION 09 93 00

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings at the following locations:
   1. Gypsum board surfaces at kitchen and other back-of-house spaces as defined in Schedule.

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.

1.03 REFERENCE STANDARDS

A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide complete list of all products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.

C. Samples: Submit two samples 8 by 8 inch (203 by 203 mm) in size illustrating colors available for selection.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
   2. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Coating Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.06 FIELD CONDITIONS

A. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).

B. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.

C. Restrict traffic from area where coating is being applied or is curing.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide high performance coating products from the same manufacturer to the greatest extent possible.

B. High-Performance Coatings:

1. PPG Paints: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
3. Tnemec Company, Inc: www.tnemec.com/#sle.
4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 TOP COAT MATERIALS

A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
   1. Colors: As indicated.

B. Epoxy Coating for gypsum board surfaces of kitchen and back-of-house areas:
   1. Number of coats: One.
   2. Product Characteristics:
      a. Single-component, pre-catalyzed waterborne acrylic epoxy.
      b. Percentage of solids by volume, 2%, minimum.
      c. Dry film thickness, per coat, 1.4 mils, minimum.
   3. Top Coat(s): Light Industrial Coating, Interior, Water Based Epoxy.
      a. Sheen: Eg-shel.
      b. Products:
         1) Benjamin Moore HP3420 Pre-Catalyzed Waterbased Epoxy: www.benjaminmoore.com/#sle.
         2) Sherwin-Williams; Pro Industrial Pre-Catalyzed Waterbased Epoxy; MPI #151, 153: www.protective.sherwin-williams.com/#sle.
         3) Substitutions: Section 01 60 00 - Product Requirements.
   4. Primer: As recommended by coating manufacturer for specific substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

3.02 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in "MPI Architectural Painting and Specification Manual".

B. Apply in uniform thickness coats, without runs, drips, pinholes, brus09 96h marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 SCHEDULE

A. Interior Paint Systems locations are indicated on drawings.

B. Colors: As indicated on Finish Schedule.

C. Gypsum board surfaces in Kitchen and Kitchen Storage areas, Janitor Closets: Epoxy, egshell.

END OF SECTION 09 96 00

SECTION 10 21 16
PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plastic-laminate-clad toilet compartments.

B. Plastic-laminate-clad urinal screens.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Manufacturer's qualification statement.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle materials and products in accordance with manufacturer's instructions, recommendations, and industry standards.

B. Store products indoors in manufacturer's or fabricator's original containers and packaging, with labels clearly identifying product name and manufacturer. Protect from damage.

C. Do not store where ambient temperature exceeds 120 degrees F (49 degrees C).

1.08 FIELD CONDITIONS

A. Ambient Conditions: Maintain environmental conditions such as temperature, humidity, and ventilation within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Existing Conditions: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.09 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Moisture Guard Plastic Laminate Finish Warranty: Provide 5-year manufacturer warranty against discoloration or delamination of Moisture Guard plastic laminate properly maintained in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturer: American Sanitary Partition Corporation.

B. Other Acceptable Manufacturers:
   1. ASI Global Partitions.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

A. Fabrication:
   1. Fabricate toilet compartment components to sizes indicated.

2. Coordinate requirements and provide cutouts for through-partition toilet accessories.
3. Provide shoes and caps at pilasters and posts to conceal anchorage, supports, and leveling mechanisms.
4. Provide manufacturer's standard corrosion-resistant supports, leveling mechanisms, anchors, and anchoring assemblies for pilasters and posts.

2.03 COMPONENTS

A. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces of 45 pcf (720 kg/cu m) density, resin-impregnated particle board core; with Moisture Guard Edge Banding.
   1. Plastic Laminate Color: As selected from manufacturer's color card, matte finish.

B. Door and Panel Dimensions:
   1. Thickness: 1 inch (25 mm).
   2. Door Panel Height: 58 inches (1473 mm).
   3. Door Height Above Floor: 12 inches (305 mm).

2.04 MATERIALS

A. Particleboard for Core: ANSI A208.1 composed of wood chips, sawdust, or flakes, made with waterproof resin binder; of grade to suit application; sanded faces.

B. Plastic Laminate: NEMA LD 3, HGS.

C. Adhesive: Contact type.

2.05 HARDWARE AND ACCESSORIES

A. Brackets:
   1. Stirrup Type: Chrome-plated zamac.

B. Door Hardware: Brushed stainless steel:
   1. Hinges: Brushed stainless steel wrap-around pivot hinges, gravity type, adjustable for door close positioning; two per door.
   2. Latch and Keeper: Brushed stainless steel surface mount slide latch.
   3. Coat Hook: Manufacturer's standard coat hook with rubber bumper; one per compartment, mounted on door.

C. Attachments, Screws, and Bolts: Chrome-plated zamac , tamper-resistant type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that field measurements are as indicated.

C. Verify correct spacing of and between plumbing fixtures.

D. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's written instructions.

B. Attach panel brackets securely to walls using anchor devices.

C. Attach panels and pilasters to brackets. Locate head rail joints at pilaster centerlines.

3.03 TOLERANCES

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).

B. Adjust adjacent components for consistency of line or plane.

3.05 CLEANING

A. Clean partition and screen surfaces with materials and cleansers in accordance with manufacturer's recommendations.

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Under-lavatory pipe supply covers.

C. Utility room accessories.

D. Wall-mounted mirror units.

1.02 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Ceramic washroom accessories.

B. Section 10 21 17 - Phenolic Toilet Compartments: Partition-mounted hook.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a (Reapproved 2019).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2018.

F. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017.

G. ASTM C1036 - Standard Specification for Flat Glass; 2021.

H. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

B. Keys: Provide four keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

F. Zinc Alloy: Die cast, ASTM B86.

G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.03 FINISHES

A. Stainless Steel: Satin finish.

B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish.

C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.

D. Powder Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat and two finish coats powder coat enamel.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper (Tissue) Dispenser: As indicated on drawings.

B. Paper Towel Dispenser:
   1. As indicated on drawings.

C. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036, Unless otherwise specified in Division 8 section, Mirrors
   1. Stainless steel framed
      a. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
      b. Size: As indicated on drawings.
      c. Frame: 0.05 inch (1.3 mm)angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.

D. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.
      b. Dimensions: 1-1/4 inch (32 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
      c. Finish: As indicated on drawings.
      d. Length and Configuration: As indicated on drawings.

2.05 UNDER-LAVATORY PIPE AND SUPPLY COVERS

A. Under-Lavatory Pipe and Supply Covers:
   1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
   2. Construction: 1/8 inch (3.2 mm) flexible PVC.
      a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.06 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
   2. Hooks: Two, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   4. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As indicated on drawings.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

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SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 SUBMITTALS

A. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Nystrom, Inc: www.nystrom.com/#sle.
   2. Potter-Roemer; Model 3000 Series ABC: www.potterroemer.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Nystrom, Inc: www.nystrom.com/#sle.
   2. Potter-Roemer; Alta 7000 Series: www.potterroemer.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 5 pound (2.27 kg).
   3. Finish: Baked polyester powder coat, red color.
   4. Temperature range: Minus 65 degrees F (Minus 54 degrees C) to 120 degrees F (49 degrees C).

C. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gauge.
   1. Class: K type.
   2. Size: 1.6 gallons (6 L).
   3. Finish: Polished stainless steel.
   4. Temperature range: Minus 20 degrees F (Minus 29 degrees C) to 120 degrees F (49 degrees C).
   5. Location: Concessionarie.

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Basis-of-Design Manufacturer: Potter Roemer:
   1. 7057-F-FP-VR

C. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; 0.036 inch (0.9 mm) thick base metal.

D. Fire Rated Cabinet Construction: One-hour fire rated.
   1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.

E. Cabinet Configuration: Recessed type.

F. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.

I. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 48 inches (1220 mm) from finished floor to inside of top of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

3.03 SCHEDULES

A. Kitchen: Qty. 3 Type K Fire Extinguishers, wall hung. Qty. 1 Type 2A Fire Extinguisher, wall hung.

B. First Floor: Qty. 2 Type 2A Fire Extinguishers, in recessed cabinets.

END OF SECTION 10 44 00

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural millwork.

B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Tile for countertops.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2017, with Errata (2019).

C. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.

D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

E. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.

F. PS 1 - Structural Plywood; 2023.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

D. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD 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 absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Natural Stone Countertops: Stone slabs bonded to substrate; use as large pieces as possible with inconspicuous adhesive joints.
   1. Stone: Marble without cracks, voids, or pin holes .
      a. Color: As indicated on drawings.
   2. Stone: Limestone without cracks or voids.

a. Color: As indicated on drawings.
b. Quarry Name: Tennesee Marble Company.
3. Stone Thickness: As indicated on drawings.
4. Surface Finish: Honed, non-glare.
5. Back and End Splashes: Same material, same thickness; for field attachment.

C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 1-1/4 inch (32 mm), minimum.
2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
a. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
b. Finish on Exposed Surfaces: Polished.
c. Color and Pattern: As indicated on drawings.
3. Other Components Thickness: 3/4 inch (19 mm), minimum.
4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
5. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.

B. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch (25 mm) except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
2. Height: 4 inches (102 mm), unless otherwise indicated.

C. Stainless Steel: Fabricate tops up to 144 inches (3,657 mm) long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
1. Weld joints; grind smooth and polish to match.
2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
3. Provide wall clips for support of back/end splash turndowns.
4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.

D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 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.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet (3 mm in 3 m), maximum.

B. Offset From Wall, Countertops: 1/8 inch (3 mm) maximum; 1/16 inch (1.5 mm) minimum.

C. Field Joints: 1/8 inch (3 mm) wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

3.07 SCHEDULES

A. Countertops
   1. CT-01: Natural Stone, marble, as indicated in drawings.
   2. CT-02: Natural Quartz and Resin, as indiciated in drawings.
   3. CT-03: Not used.
   4. CT-04: Natural Stone, limestone, as indicated in drawings.

END OF SECTION 12 36 00

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SECTION 23 05 00
COMMON WORK RESULTS HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Related Sections:
   1. All sections within Division 23 – Heating, Ventilating, and Air Conditioning.
   2. All sections within Division 01 – General Requirements.

1.02 SUMMARY

A. The requirements of this section apply to all the Work of Division 23.

B. This Section Includes the following:

C. Applicable codes.
   1. General project requirements.
   2. Concrete pads.
   3. Rooftop equipment support.
   4. Roof openings and curbs.
   5. Grout.
   6. Access panels.
   7. General installation requirements.
   8. General testing requirements.

1.03 REFERENCES

A. References to standard codes, specification of regulatory agencies shall mean editions in effect at date of proposal. Reference to technical societies, trade organizations, and governmental agencies is made in this Division in accordance with the following abbreviations:

1.	AABC	Associated Air Balance Council
2.	ADCD	Air Diffusion Council - Test Code
3.	AGA	American Gas Standard
4.	AMCA	Air Moving and Conditioning Association
5.	ANSI	American National Standards Institute
6.	ARI	Air Conditioning and Refrigeration Institute
7.	ASA	American Standards Association
8.	ASC	Adhesive and Sealant Council
9.	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
10.	ASME	American Society of Mechanical Engineers
11.	ASSE	American Society of Sanitary Engineering
12.	ASTM	American Society for Testing and Materials
13.	AWS	American Welding Society
14.	AWWA	American Water Works Association
15.	CISPI	Cast Iron Soil Pipe Institute
16.	CS	Commercial Standards - US Dept.
17.	EPA	Environmental Protection Agency
18.	FMS	Factory Mutual System General Industry Safety Orders, Article 3281
19.	HEW	US Dept. of Health, Education and Welfare
20.	HI	Hydraulic Institute
21.	IAPMO	International Association of Plumbing and Mechanical Officials
22.	IBC	International Building Code
23.	IECC	International Energy Conservation Code

24.	IFC	International Fire Code
25.	IMC	International Mechanical Code
26.	IMSS	Manufacturers' Standardization Society
27.	IPC	International Plumbing Code
28.	IRI	Industrial Risk Insurers
29.	LEED®	Leadership in Energy and Environmental Design
30.	NBS	National Bureau of Standards
31.	NCWB	National Certified Piping Welding Bureau
32.	NEBB	National Environmental Balance Bureau
33.	NEC	National Electrical Code
34.	NEMA	National Electrical Manufacturers' Association
35.	NFPA	National Fire Protection Association
36.	OSHA	Occupational Safety and Health Administration
37.	PDI	Plumbing and Drainage Institute
38.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
39.	UL	Underwriters Laboratories, Inc.
40.	USGBC	United States Green Building Council

1.04 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and crawlspace below First Floor slab.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. "Regulating Authorities" means all governmental, utility and fire protection authorities having jurisdiction.

G. "Provide" means to supply, erect, install and connect up completely, in readiness for regular operation, the particular work referred to.

H. "Furnish" means purchase, store and deliver the specified material, equipment or other item to the person or party indicated.

I. Approved Equal" means any equipment or material which in the opinion of the architect, is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and will function adequately in accordance with the general design.

J. "Singular Number": Where any device is herein referred to in the singular number, such reference shall be deemed to apply as many such devices as are required to complete the installation or as many as are shown.

K. "Piping" as used in the drawings and specifications means all pipe, fittings, nipples, flanges, valves, unions, hangers and supports that are required for a complete functional system.

L. "Ductwork" as used in the drawings and specifications means all ductwork, fittings, dampers, air terminal devices, diffusers, registers, grilles, hangers and supports that are required for a complete functional system.

M. "Wiring" includes, in addition to conductors, all raceways, conduit, fittings, boxes, switches, Contract Documents" or "Documents" shall mean the latest version of all drawings and specifications prepared by the Engineer and Architect.

N. “Authority Having Jurisdiction” or “AHJ” shall mean the building department, fire department, inspectorate or other authority having legal jurisdiction relevant to the specific work being described in the City or State where the project is located.

O. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PE: Polyethylene plastic.
   3. PVC: Polyvinyl chloride plastic.

P. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

Q. hangers and other accessories related to such wiring

1.05 REGULATIONS, CODES, PERMITS AND FEES

A. Before bidding, be familiar with rulings of inspection departments and comply with such requirement. Codes, standards and specifications applicable to this work shall be the latest editions in effect at the date of the proposal.

B. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.

C. All work and material shall be in full accordance with the latest rules and regulations of the following agencies:
   1. Safety Orders of the Division of Industrial Industry
   2. International Building Code
   3. International Mechanical Code
   4. National Electric Code
   5. National Fire Protection Association Pamphlets 13, 14, 24 and 291
   6. Listing and approval of Underwriters’ Laboratories, Inc. where available and applicable.
   7. Listing and approval of American Gas Association where available and applicable.

D. Rulings and interpretations of authorities shall be considered a part of the regulations.

E. Where the standards of the drawings and specifications for materials and/or workmanship are higher than the requirements of the documents cited above, the drawings and specifications shall take precedence; otherwise the documents shall govern.

F. Nothing in these plans or specifications is to be construed to permit work not conforming to these codes and regulations.

G. Should there be any direct conflict between the above rules and the specifications, the rules shall govern.

H. Charges for all materials and labor required for compliance with these rules and regulations shall be included in the Bid Price.

I. Give necessary notices, obtain permits and pay taxes, fees and other costs in connection with work; file necessary plans, prepare documents and obtain necessary approvals of regulating authorities having jurisdiction; obtain all required Certificates of Inspection for Work and deliver to Architect before request for acceptance and final payment for Work.

J. Include in Work, without extra cost to Owner, labor, materials, services, apparatus, drawings (in addition to Contract Drawings and Documents) required to comply with applicable laws, ordinances, rules and regulations.

K. Conform to all rules, regulations, laws, and ordinances governing the area in which this construction occurs.

L. Obtain the required permits from the local authorities for this work and pay for all fees required by the State and Federal authorities for permits, inspections and review, including special agency construction

and operating permits. Make corrections in the work as required by the Owner's Representative or Inspector to pass local regulations.

M. Provide local authorities with all notices relating to this Division.

N. Provide Owner, Owner's Representative and local Inspectors access to work at all times.

O. Contractor shall be responsible for all law violations caused by the work under this Division. Notify the Owner's Representative in writing when a discrepancy occurs between code requirements and work shown on drawings and resolve matter before proceeding with work.

P. Make application and pay for all certificates of inspection, taxes and permits required by Local, State or Federal Governments, public utilities, or other authorities having lawful jurisdiction. Deliver to the Owner's Representative any and all certificates of inspections, permits, and approvals that may be required by such authorities.

Q. Permits and Fees
   1. Make application and pay for all certificates of inspection, taxes and permits required by AHJs. Deliver to the Owner any and all certificates of inspections, permits, and approvals which may be required by AHJs.
   2. Pay all utility charges and charges for providing temporary and permanent water, sewer, and gas services to buildings.

1.06 GENERAL REQUIREMENTS

A. Provide a complete mechanical system in full working order without objectionable noise or vibration. The documents do not undertake to show or list every item to be provided. The Contractor shall examine the Documents at the time of the bid and notify the Architect/Engineer in writing of any and all discrepancies. When an item not shown or listed is necessary for the proper operation of equipment which is shown or listed, provide an item which will allow the system to function properly at no increase in Contract Sum. Should there be any direct conflict in the specifications and drawings, an RFI shall be submitted with the Contractor’s suggestion for resolution.
   1. Provide and install complete direct digital control system, including devices, controllers, and sensors.
   2. Provide testing, adjusting and balancing for all systems. Refer to Section 23 05 93.
   3. Provide, design, dimension, coordinate, and install the following items specified as design build under specified performance criteria:
      a. Support and anchorage of all equipment, valving, piping, duct work, duct silencers and controls equipment and conduit. Refer to Section 23 05 29.
      b. Thermal and seismic expansion. Refer to Section 23 05 16.
      c. Vibration isolation and seismic anchorage. Refer to Section 23 05 48.
      d. Controls programming, architecture, and conduit sizing and routing. Refer to Section 25 55 00 and 25 55 10.
   4. Provide all control devices for mechanical equipment and systems in conjunction with control system requirements, including coordination with Division 26 for electrical connection for complete, tested and operational systems.

B. Construction Documents Drawings and Data
   1. The drawings show the general arrangement of all piping, ductwork, conduit and equipment. Examine drawings and specifications carefully, and notify the Owner's Representative by letter or Request for Information (RFI) of any discrepancies so these can be rectified at an early date.
   2. Should conditions necessitate any rearrangements, the Contractor shall prepare and submit drawings showing the changes before proceeding with the work. If such changes are approved, they shall become a part of this contract after their approval.
   3. Due to the small scale of the drawings, it is not possible to show all offsets and every detail of construction. Additional fittings, valves, traps, transitions, ducts, etc., shall be furnished and installed at no extra cost to the Owner. It is not the intent of Drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.

4. The drawings are diagrammatic and are a graphic representation of the Contract Requirements, and are intended to convey scope of work. Dimensions of work as indicated on plans are not guaranteed to be as-built dimensions. No measurements shall be scaled from the Drawings for use as a definite dimension for layout or fitting work in place. Location of all items not definitely fixed by dimensions are approximate only. The Contractor is solely responsible for dimensional control and coordination of the work to be installed.
5. The layout of equipment, as shown on the plans, shall be checked and exact location determined by dimensions of equipment accepted for installation. Consult the Architectural and Structural Drawings for all dimensions, locations of partitions, sizes of structural members, foundations, etc. Exact locations necessary to secure best conditions shall be determined in field coordination and shall be approved by the Owner's Representative prior to installation. In addition, the Owner's Representative reserves right at no increase in contract sum to make any reasonable change in location of mechanical items exposed at ceilings or on walls to group them in an orderly relationship or increase utility and access.
6. The Contractor shall be responsible for the coordination of the mechanical ducting and piping distribution with the fire sprinklers, lighting, conduit, cable tray, structural members, ceiling support and all other trades present within the project.
7. At the Owner's direction, electronic files of the documents may be available to the Contractors subject to the following caveats:
    a. Provision of electronic files does not release the contractor from the requirements of the Contract Documents regarding coordination, submittals or any other issues outlined in the Contract Documents.
    b. The official Contract Documents are the hard copy versions, not the electronic files.
    c. The Contractor is responsible for all information extracted or inferred from the electronic files.
    d. Submission of the electronic file unchanged as a shop drawing will be rejected without review.
    e. These documents are provided only as a convenience to the Contractor. The Architect/Engineer is under no obligation to provide updated drawings during the Construction Phase or to track changes arising from RFIs, change orders, substitution requests, or submittal-generated alterations.
8. Any conflicts between 3D files, 2D files, sections, detail drawings, single line drawings, and specifications are to be resolved by a Request for Information (RFI).

C. Minor Deviation from Construction Documents
1. The equipment listed by model number and manufacturer in the plans and specifications has been selected for its capacity, certain standard construction features and specified optional features.
2. The dimensions and ratings of equipment herein specified or indicated on the Drawings are intended to establish the desired performance characteristics of such equipment. Minor deviations may be permitted after review by the Owner's Representative to allow manufacturers specified to bid on their nearest standard equipment that provides at least the performance required.
3. Manufacturers' catalog or model numbers and types mentioned in the Specifications or indicated on the drawings are intended to be used as guides and shall not be interpreted as taking precedence over specific ratings or duty called for or shown, which modify stipulations in such catalogs. In all cases, the manufacturer shall verify the duty specified with the particular characteristics of the equipment he intends to submit, and shall submit only items which comply with Specification requirements.
4. Where the equipment furnished differs in physical character from that specified or indicated, or where Contractor's substituted equipment requires increased service and facilities to be provided by other trades, and such substitution is acceptable to the Owner's Representative, the Contractor shall bear all costs of providing services, facilities and modifications to the system or building.
5. Where the equipment furnished requires redesign of systems, connections, or configuration, and such substitution is acceptable to the Owner's Representative, the contractor shall bear all costs associated with design engineering and shall pay the time and materials cost of the Owner's Representative's review of this documentation. In addition, it is the contractor's responsibility to obtain approval from the authority.

6. For routing of air, water, or steam distribution and conduits, the contractor is empowered to suggest an optimized routing or resizing, given that the routing has been entirely field coordinated, it adds no pressure drop, it does not disturb the functional intent, there is no charge to the client, and all changes are explicitly annotated through symbols in the shop drawings as having deviated from the construction documents proposed routing solution.
7. The shifting of any item horizontally by less than 10', the change of any elevation by less than 3', the resizing of ductwork for equivalent frictional loss, and the necessary fittings in order to accomplish this shall all be construed as accommodation for field coordination and cannot be back-charged as change orders to the client.

1.07 SUBMITTALS PROCEDURES

A. Section 01 33 00 - Submittal Procedures: Submittal Procedures apply to this section. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Preliminary Submittals
   1. Preliminary List of Materials, Equipment and Subcontractors
      a. Submit a Preliminary List of Materials, Equipment and Subcontractors to the Owner's Representative for approval of manufacturers of all materials and equipment proposed to be provided for this project, and contact information for all proposed Subcontractors. List shall be configured as follows:

Specification/ Section number	Clause Number	Equipment Type	Proposed Manufacturer/ Contractor Name	Proposed Manufacturer Model Series/ Contractor contact information	Is this Manufacturer/contractor named in the drawings?	Is this Manufacturer/ contractor named in the Specifications ?	(For Owner's Representative)	
							Is this a Substitution?	Rejected?

      b. List will be returned to the contractor with marks in the far right column with regards to whether the particular manufacturer is rejected due to poor past performance or known incompatibilities with the requirements. Lack of comment in these columns does not imply that the final manufacturer/model proposed will be acceptable. In all cases, the contractor bears the responsibilities to prove that the proposed product meets the specification and the performance required in the documents.
      c. The review of the Preliminary List of Material, Equipment and subcontractors shall only be construed to be a general review that the manufacturer or subcontractor is a recognized and reputable supplier of that general type of product or service and therefore eligible to submit in detail for review. The review designation of "no exception taken" to the Preliminary List does not exempt the Contractor from proving that the particular and specific equipment or Subcontractor meets the project's requirements during the Submittal phase.
      d. Submit the List of Materials, Equipment and Subcontractors for review in accordance with Section 01 33 00: Submittal Procedures. Submit at least two months prior to the first submittal.
   2. Submittal Schedule
      a. Provide a submittal schedule at least two months prior to the first detailed submittal.

b. The submittal schedule shall be a complete list of all submittals to be made with submittal number, projected date of submittal, description of submittal by Specification or drawing number and whether a substitution is proposed.
c. The submittal schedule shall include worst-case submittal status, resolution date and the critical path's target installation date, assuming at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Complicated submittals, such as controls and motorized machinery, shall incorporate time for at least 2 "Revise and Resubmit" cycles. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.
d. Concurrent submissions of multiple submittals shall incur a minimum of two times the turnaround time listed in Division 1, or longer, as agreed between reviewing party and the Owner's Representative, based upon the amount and detail level of the documents requiring review. The following items shall be submitted for concurrent reviews:
   1) All controls submissions shall arrive concurrently to allow cross-referencing.
   2) All air handling equipment and duct silencers shall arrive concurrently.
   3) All VFD submittals (including those embedded in equipment submittals as integral devices) shall be included in VFD harmonic mitigation calculation submittal for reference.
e. The contractor shall be responsible for equipment ordered and/or installed prior to receipt of submittals returned bearing the Architect/Engineers stamp of "No Exception Taken". Corrections or modifications to equipment as noted on returned submittals shall be at the Contractor's sole expense without additional compensation.

3. Shop Drawing Schedule
   a. Provide a shop drawing submittal schedule that includes fixed dates of inter-trade coordination sign-off prior to submission, including TAB and controls Contractors.
   b. The schedule shall be a complete list by drawing number of all shop drawings to be made, along with projected date of submission, worst-case shop drawing status resolution date, and critical path's target installation date.
   c. The submittal schedule shall assume at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.

C. General Organization of Submittals
1. Submit as a minimum all the required data listed in the documents as specifying performance, material, and dimensions. Refer to individual specification sections, schedules, and drawings for requirements.
2. Organize submittals in the same sequence as they appear in specification sections, articles or paragraphs. Label each page with the appropriate specification clause number or drawing detail number.
3. Each submission shall be made under the Specification Section Number it has been specified under. Submittals including equipment specified under a different specification section will be rejected and returned without review. Each section is required to be tracked separately for status designation, even if multiple sections are physically collated into a single binder.
4. Identify each item within each submittal by reference to Specification Section paragraph in which the item is specified, or Drawing and Detail number. Annotate the submittal sheets with the equipment identification numbers appearing on the equipment schedule.
5. Include all information requested by the Specification Section in a single submittal. With the exception of shop drawings, incomplete submittals or phased submittals under the same specification section are not acceptable and will be returned without review, with the Contractor responsible for any resultant consequence.
6. Submit pertinent catalog and performance data sheets only. Annotate pages to clearly identify which specific product is submitted and for what tag number or application. Contractors shall not submit entire catalogs, extraneous information or optional choices. Contractor shall cross out any irrelevant information that may exist on the page, including unadopted options or alternative model types.

7. Submission shall be made in the form of a tab-indexed 3-ring brochure or binder of 8½“ x 11” pages or 11” x 17” pre-folded to fit. Index sheets shall be required for all material and equipment, including pipe, valves, insulation, conduit and wire as listed. Index sheets shall be set up, in the same sequence as the specifications, with columns to identify the following:
   a. Specification clause number or drawing/detail number
   b. Item type
   c. Tag number as appropriate and/or application
   d. Requirement from drawing schedule and specification (multiple rows may be used)
   e. Equipment or manufacturer substitution request: yes or no
   f. Feature data provided to show compliance: yes or no
   g. Compliance: yes or no
   h. Notes from Contractor
8. Provide the number of submittal and shop drawing copies as defined under Section 01 33 00.
9. Illegible submittals will be rejected and returned without review.

D. Protect existing active services (water, gas, sewer, electric) when encountered, against damage from construction work. Do not prevent or disturb operation of active services which are to remain.

E. Equipment Submittals:
1. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. At a minimum, this should include all information scheduled. Words "as specified" are not sufficient identification.
2. Mark the exact equipment item and data on each sheet. Where multiple product model types are listed on a single sheet, the contractor shall clearly indicate which specific item is submitted. If different model numbers of a single product line are submitted for different uses, this should be clearly annotated, identifying each individual use cross- referenced by the requirement it intends to fulfill. Submittals without annotation will be rejected and returned without review.
3. Submittal literature, drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item and its relevant features or options. Submittals shall include all those items listed in each individual Section.
4. Where a certificate from a regulatory agency cannot be provided at time of submission, provide a letter describing methodology used to obtain certification, authority having jurisdiction, and anticipated date of certification.
5. All built-up equipment (such as air handlers or pump packages) shall be provided with a fully dimensioned shop drawing showing all hardware, points of connection, point loads at supports and center of gravity.
6. Submittals for all factory-built equipment weighing 40 lbs or more shall include a dimensional drawing, equipment weight, and center of gravity.
7. Provide the name and contact information for the three closest manufacturer representatives/service companies for the product.
8. Manufacturer’s certificate of performance and construction.
9. All equipment shall be UL listed as a complete assembly. Submit UL listing documentation with equipment submittals.

F. Shop Drawings:
1. Prepare reproducible CAD drawings in AutoCAD.
2. Shop drawings shall be provided for all systems included in Division 23 and for all areas addressed in the Construction Documents.
3. Ductwork and piping installation drawings shall be fully dimensioned complete with elevations and all fittings, valves, dampers, devices. Include details and dimensioned locations of supports, anchors and expansion devices. Dimensions shall be from gridlines. All equipment shall be shown to scale and shall match the required dimensions from the equipment submittals. All equipment access clearances shall be marked explicitly on the Shop Drawings with manufacturer and code required distances dimensioned and annotated as such.

4. The drawings shall be minimum 1/4" = 1'-0" scale.
5. Ductwork and Piping shall be on separate drawings.
   a. Piping drawings shall include and show equipment with tags, access space, pipe material, flexible pipe connectors, pipe support type and seismic restraints, balancing devices, gauges/thermometers/Pete's plugs, controls devices, penetration locations (including dimensions and elevation), insulation type and location.
6. Penetration locations, structural support and structural pad drawings shall be submitted for review by Structural Engineer.
7. All equipment shall be labeled to match the schedules. All equipment shall be drawn to scale per the approved submittals, providing notes to identify approved submittal number for all pieces of equipment.
8. The Contractor shall ensure that each trade has coordinated work with other trades, prior to submittal. Division 23 shop drawings shall be issued after the coordination drawings are signed off by all other trades and after the system pressure loss calculations are complete. Any conflicts that occur with other trades shall be brought to the attention of the Owner's Representative prior to issuance of the shop drawings.
9. Shop fabrication, coordination and installation drawings that are prepared to scale by the Contractor are for his use and shall be his responsibility. These Drawings indicate where he intends to install the material and equipment as required by the Contract Documents. Submission of contract documents or electronic files of contract documents for shop drawings is not sufficient as this would be an indication that field-level construction coordination has not taken place. Any such submittal will be rejected and returned without review.
10. Prepare and submit supplementary Shop Drawings for all Work in "tight" areas, clearly indicating solutions to space problems and coordination with Work in other Sections. Identify congested conditions and provide a sufficient number of sections to demonstrate the solution proposed. These Drawings, as a requirement of this Division, shall indicate, superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, equipment access requirements, etc. Include all mechanical rooms at larger scale and with sections under this clause. Identification of space problems without solutions is not acceptable within a shop drawing.
11. During the shop drawing review process the Owner's Representative may request that supplementary shop drawings be produced for clarification and explicit demonstration of coordination in congested areas. This work shall be performed by the contractor at no cost as necessary under the previous clause.
12. Prepare and submit Shop Drawings for all Work deviating from that indicated on Contract Drawings. Clearly indicate deviations and cross reference through notes the reason why the deviation was made.
13. Shop Drawings shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, weight.
    a. Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of the Contract Documents.
    b. Drawings shall be to scale and dimensioned (except piping diagrams not to scale).
    c. Drawings shall clearly show all required openings in construction, points of connection of other trades, and support locations and loads.
    d. Drawings may be prepared by vendor but shall be submitted as instruments of the Contractor. Such drawings shall be thoroughly checked and developed by the contractor to include the full contract scope. They shall be stamped by Contractor before submission for review.
    e. Catalog cuts and published material may be included to supplement scale drawings.
14. Each drawing shall have a blank space for use by the Owner's Representative and Contractor in recording disposition of material per Section 01 33 00.

G. Coordinated Drawings:
   1. Refer to Section 01 33 00 Submittal Procedures for requirements.

2. Color Coordinated drawings (with different color per trade) shall be provided for all areas with acceptance sign off from all trades required at time of shop drawing submittals, including, but not limited to:
   a. Plumbing Contractor
   b. Electrical Contractor
   c. IT Contractor
   d. AV Contractor
   e. Ceiling Support Contractor
   f. General Contractor
   g. Testing Adjusting and Balancing Contractor
   h. Controls Contractor
   i. Fire Sprinkler Contractor
   j. Fire Alarm Contractor
3. Coordinated Drawings shall show work of all trades including, but not limited to:
   a. Ductwork with fully-dimensioned sized and locations of penetrations at floors, walls, ceiling and roof.
   b. Piping, including:
      1) HVAC, Plumbing and Fire Protection.
      2) Minor Piping such as Drains, Air Vents, Condensate Piping, etc.
      3) Sleeves and fully-dimensioned sized and locations of Penetrations.
      4) Expansion Devices, Anchors, Guides and Hangers, Seismic Anchorage Devices.
   c. Actual Mechanical Equipment at submitted dimensions, including points of connection and manufacturer's recommended access space. Nothing shall enter or cross through the code-required and manufacturer recommended access space, which is defined as the volume extending from the top of the device to be maintained down to the floor (inclusive of access door locations and swings). Any ceiling which interrupts this space shall be entirely removable including T-bars, vertical supports and seismic bracing of ceiling which shall be arranged to avoid the access zone.
   d. Pipe Supports and Suspension Devices, including seismic restraints.
   e. Ductwork
   f. Piping High Points and Low Points.
   g. Electrical Equipment.
   h. Main Electrical Conduits and Bus Ducts.
   i. Equipment Support and Suspension Devices including Hangers, Supports and Bracing.
   j. Structural and Architectural Constraints including Beams, Braces, Trusses, Flanges, Constraints, Walls, Openings Ratings, Doors, Wall Types and Glazing.
   k. Show location of:
      1) Valves.
      2) Chemical Treatment.
      3) Piping Specialties.
      4) Dampers.
      5) Access Doors and Equipment Removal Paths.
      6) Control and Electrical Panels.
      7) Disconnect, Hand/OFF/Auto, and Emergency Power Off Switches.
      8) Temperature / Humidity Sensors and Thermostats / Humidistats.
      9) All control sensors, control panels and required installation distances for access and stable performance.
      10) Mounting Brackets
   l. Testing, Adjusting and Balancing devices
   m. Controls devices and sensors, including required distances for uninterrupted flows to obstruction
   n. Electrical point of connections
   o. Controls points of connection

p. Fire Alarm points of connection

4. Drawings shall indicate coordination with work in other Divisions which must be incorporated in mechanical spaces, including, but not limited to:
   a. Irrigation Equipment and Piping.
   b. Elevator Equipment.
   c. Electrical Equipment.
   d. Cable Trays.
   e. Architectural features, including doors and partitions
   f. IT/Electrical outlets
   g. Plumbing equipment
5. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with routed duct mains, areas with routed piping mains, and areas adjacent to the existing structure.
6. Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided by Contractor, his decision, if consistent with Contract Document requirements, shall be final.
7. Provide templates, information and instructions to other Divisions to properly locate holes and openings to be cut or provided.
8. Not all offsets in ductwork or piping are shown. Contractor shall decide which item to offset or relocate. Maintain required slope in piping.
9. Provide wiring diagrams for electrical, controls and fire alarm systems cross referencing panel location/circuit number/point name as appropriate.

H. Substitutions:
   1. In accordance with Section 01 60 00, and where permitted in each section.
   2. Specified products or equipment mean those named on the equipment schedules or identified as Specified Manufacturers herein. All other manufacturers listed are considered substitutions and must meet the requirements of this Section. Only manufacturers identified as Possible Substitutions in this specification may be offered as substitutions for approval.
   3. Substitution requests shall come simultaneous to the relevant submittal and shall not come through the RFI process, unless directed by the Owner's Representative. The first page of the submittal containing the substitution request shall explicitly include a table of contents identifying the location of the official substitution request paperwork, the table of comparisons, and the supporting data.
   4. Submit shop drawings of proposed products that differ from the specified products to demonstrate equivalency of connections and physical arrangements. Show necessary modifications of architectural, structural, plumbing, electrical and mechanical Work required by the proposed products, including relocation of drains, revised electrical circuits, relocation of roof or wall penetrations, and revised foundations.
   5. Accompany request for substitution review with table of comparison listing pertinent features of both specified and proposed materials including all scheduled data, material of construction, performance criteria, overall length, width, height dimensions, space required for replacement or maintenance access, motor type, horsepower, voltage, phase service factor, noise levels and controls. This is to be submitted in addition to the index sheet required above for all submittals. Review of proposed substitution will not be made without simultaneous receipt of satisfactory comparison tabulation. The substitution request shall also identify the offered reduction in contract value, which shall be inclusive of all cost associated with work by other trades. If paper copies of data from the referenced manufacturer are provided along with the submitted manufacturer as backup data for the table of comparisons, these shall be explicitly separated via tabs clearly marked as follows:
      a. Substitution request, comparison table, letter sign-off by all affected subcontractors verifying that there is no charge to the project associated with the substitution
      b. Submitted data from requested manufacturer
      c. Reference data from specified manufacturer
   6. Limit submittal of substitutions to one proposal for each type or kind of item. If the proposed product substitution is rejected, submit the specified product at no cost to the project.

7. Review of drawings and other material submitted as a substitution shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other Work. The submittal response of “No Exception Taken” to a substitution request does not constitute a design change or a direction from the Owner and it is not eligible for a change order request.
8. Any additional work required by other trades as a result of a substitution shall be covered under this Contract, without any additional cost or time delay imposed on the project. Submittals with substitution requests shall include a letter signed by all affected parties (electrical, controls, testing, adjusting, and balancing, general contractor, structural capacity) verifying that the substitution will not incur any additional cost or time delay to the overall project.
9. When a substitution is proposed, the Contractor shall be responsible to ensure that the performance and quality of the scheduled or specified equipment is met. If additional accessories are required to achieve performance, they shall be provided at no cost.
10. Substitutions shall be made explicit during the project buy-out/bid phase (e.g. guaranteed maximum pricing). Selection of the sub-contractor does not imply acceptance of substitutions.

I. Submittals – Checking
1. Before submitting shop drawings or equipment submittals to the Owner's Representative, the contractor shall check them in detail to be sure that all requirements of the plans and specifications have been fully met.
2. Incomplete submittals and submittals not in accordance with the above requirements shall be returned without action, and resubmittal shall be required.
3. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, to coordinate with the other trades and to effect necessary rearrangement or construction of other Work.
4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these Drawings. Review is for general conformance with design concept of the Project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the Jobsite, for fabrication processes and techniques or construction, for coordination of his Work with that of all other trades, for installed performance and the satisfactory quality of his work.
5. Review by the Owner's Representative of Submittals does not release the Contractor from full compliance with the requirements of the plans and specifications when Submittals deviate from these requirements.
6. Even though Submittals have been stamped "Reviewed" and no exceptions have been taken by the Engineer, the Contractor shall be fully responsible for all unauthorized deviations from the Drawings and specifications. Authorization for deviation will be made only by means of a letter from the Owner's Representative. The Owner's Representative's reviewed "No Exceptions Taken" stamp on a Submittal is not an authorization for a deviation from the plans and specifications.
7. Any corrections or modifications made by the Owner's Representative shall be deemed acceptable to the Contractor with no change in contract amount unless written notice is received by the Owner's Representative prior to the performance of any work affected by any corrections or modifications.
8. No material or equipment shall be released for manufacturer or shipment without first obtaining the Owner's Representative approved shop drawings.

J. Resubmittals
1. Resubmittals shall be reviewed for compliance with the comments made on the original submittal. Clearly identify replies to comments, through a cover letter by the Contractor that lists each comment and the resolution of that comment. Mark with submittal number and date.
2. Non-compliant items which were not noticed in an earlier submittal but are noticed in a resubmittal shall be noted as non-compliant and the resubmittal tagged for corrective action. The fact that the Owner’s Representative may have overlooked the defect shall not constitute total or partial

acceptance of it. The contractor remains responsible for delivering an installation that meets the design intent. All corrective action shall be performed at no additional cost or delay to the project.

3. Re-submittals shall be complete and shall be explicitly annotated to note all changes. Contractor shall not just include specific responses to review comments, but shall show how the resubmittal data has been corrected and how all consequences of the change have been accommodated.
4. Changes made in the resubmittal which are not directly a response to an earlier review comment shall be clearly identified on the letter of transmittal provided with the re- submittal and annotated within the body of the submittal. The reason for the change shall be included.
5. One resubmittal will be reviewed. Review time for all second and higher resubmittals will be charged on a time and materials basis to the contractor regardless of the cause of the resubmittal. This will include all submittals to change manufacturer or equipment type after an original submittal was returned with no exceptions taken, unless the change is directly related to a Bulletin.

1.08 PROJECT RECORD DOCUMENTS

A. In accordance with Section 01 70 00 - Execution and Closeout Requirements: Record Documents, and as follows.

B. Keep up-to-date during the progress of the job through, one set of drawings indicating the Record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base line reference points:
   1. Exact location, type, and function of all valves, dampers, and controllers (cross referenced to valve, damper and sensor/controller charts).
   2. Exact size, invert elevations and location of underground and underfloor piping and ducts, and ducts and piping concealed or exposed in walls.
      a. Dimensional changes to Drawings.
      b. Revision 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 Directives.
      k. Details not on original Construction Drawings.

C. Underground utility services, both inside and outside of buildings, shall be dimensioned from permanent structures or bend mark. Utility services outside of buildings shall also show depth of burial with reference to the finished ground floor elevation. Mark record prints of Construction Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Construction Drawings location.
   1. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location. All notations shall be dated and initialed. Record drawings shall note related change order designations (numbers) on impacted work.
   2. Mark important additional information that was either shown schematically or omitted from original Drawings.
   3. Note alternate numbers, Change Order numbers, and similar identifications.
   4. Responsibility for Markup: Under direct supervision of Contractor, the individual, installer, subcontractor or other entity who obtained record data shall prepare markup on record drawings.
      a. Accurately record information in an understandable drawing technique.
      b. Record data as soon as possible after obtaining it. Record and check markup prior to enclosing concealed installations.
      c. Encircle each area of change or additional information with a free-form cloud- shape drawn on the reverse side of the transparency.

d. Identify changes and additional information by printing Change Order Number or other change reference designation, when applicable, within the cloud-shape encircled area.

5. During construction phase, maintain in addition to hard copy, an electronic record document of drawings on CAD file, with 2 back up copies.
6. Transfer markup's from hard copy to CAD files on a monthly basis.
7. Submit one hard copy of changes made to CAD files as part of monthly request for payment,
8. Provide and maintain a list of drawings.

D. A complete progress set of drawings shall be kept on the project site at all times and shall be available for inspection by Owner's Representative or Construction Manager weekly, as a "record" set.

E. Each trade shall submit record copies of their respective shop drawings as part of the project closeout. These record copies shall indicate as-built conditions and shall show all work installed by that trade. All elements shall be dimensioned from grid lines or bench marks and all elevations shall be noted. Construction notes such as component number or conflict notes shall be removed and the drawings shall clearly be noted in the title block as being as-built drawings.

F. Newly Prepared Record Drawings: Prepare new drawings instead of following procedures specified for preparing record drawings where new drawings are required when neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation. New drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

1. Provide Drawings in a scale that allows for scope of detailing and notations required to record actual physical installation and its relationship to other construction.
2. When completed and accepted, integrate newly prepared Drawings with procedures specified for organizing, copying, binding and submitting record drawings.

G. Submit as a normal submittal, a copy of the completed progress set Drawings and the final draft of the project record drawings to Owner's Representative for approval prior to authorization for final payment. Record drawings shall be certified as to their correctness by the signature of the Contractor and shall be stamped or otherwise identified as record drawings.

H. Prior to Final Acceptance, submit record drawings to the Owner. Organize into sets, and bind and label.

I. At the completion of the project prior to the authorization for final payment, the Contractor shall submit record as-built drawings with numbers of copies as specified under Section 01 70 00 and their electronic CAD files, including all associated reference files, files related to line weights/color for printing, and a PDF print of the intended final drawing product. Drawings shall incorporate all the Owner's comments and corrections, submittal information, RFI information and all addenda and represent completed as-built conditions. Reference to RFI's or Change Orders in lieu of drawing the exact change will not be acceptable. Title block shall explicitly note these as "PROJECT RECORD DRAWINGS" in a prominent location on each drawing.

J. Contractor shall deliver rolls or binders that contain each drawing, whether or not changes and additional information were recorded, such that each copy is a complete as-built representation of the installed work.

1. Organize hard copies into manageable sets. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.
2. Organize and bind original marked-up set of prints that were maintained during construction period in same manner.
3. Submit marked-up progress set, record set, CAD files, and copy sets to the Owner.

1.09 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Instructions and Manuals: Provide number of copies in accordance with requirements of Section 01 70 00 and parallel electronic documentation organized in directories. Additional requirements are parallel to the paper copies. Additional requirements are as follows:

1. Subsequent to completion of balancing and testing operations, this Division is responsible for instructing the Owner's authorized Representatives in all aspects of operation, adjustment and maintenance of mechanical plant and other mechanical equipment. Provide video documentation of training session on DVD.

2. Provide a minimum of 8 hours Owner training for each major system (e.g. boiler plant, chiller plant, air handlers, BAS, etc.). Provide a minimum 4 hour Owner training session for the building's non-major systems (e.g. toilet exhaust fans, valves, etc.).
3. Submit certificate, signed by Owner's Representative, attesting to their having been instructed per Section 01 70 00 and as specified under individual Equipment sections of this specification.
4. Instructions on major items such as pumps, chillers, boilers, water heaters, water treatment, fans, air handlers, and temperature control shall be by representative of manufacturer of the respective equipment.
5. Schedule training with Owner's representative a minimum of 5 working days in advance. All Owner training shall be completed prior to scheduling final inspection.
6. One month prior to request for final inspection, submit Operating and Maintenance manuals and electronic documentation under Section 01 70 00.
7. Manuals shall be prepared to ASHRAE Guideline 4-2008. The manuals shall be predominately typewritten with occasional printing or hand-drawn demarcations and notes. Shall include the following in the Equipment Binder(s):
    a. Section 1: Overview documents:
        1) A comprehensive table of contents and guide to the manuals contents and layout. This section shall enable the reader to comprehend the scope and purpose of the document and to identify readily where specific information can be obtained.
        2) Equipment List: List of all major equipment as installed. Include tag reference model number, normal capacities, location in building, and location tab number in Section 3 binders.
        3) Manual valve charts organized on a room and sequence basis, identifying room, system, valve numbers, valve type, valve usage, and associated equipment.
        4) Manual fire and fire smoke damper charts organized by type on a room and system basis, detailing room system and damper number.
    b. Section 2: Contractual and Legal Records including:
        1) Name and Address of the installation.
        2) Contact Name and telephone number for emergency repairs.
        3) Details of City and State approvals.
        4) Name and Contact details of the Design Team and Installing Contractors and associated sub-contractors.
        5) Copies of maintenance service contracts and contact details for local service company.
        6) Master Equipment List containing Dates for Start of Installation, Substantial Completion, and Expiry of Warrantee period.
        7) Copies of warrantees, guarantees and bonds.
    c. Section 3: Individual Equipment Sections:
        1) Startup and Shutdown Procedures:
            a) Provide a step-by-step write-up of all major equipment. When manufacturer's printed start-up, troubleshooting and shut-down procedures are available, they shall be incorporated into the operating manual for reference.
        2) Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
        3) Service Instructions: Provide the following information for all pieces of equipment:
            a) A detailed parts list
            b) Recommended spare parts, including catalog number and the name, manufacturer's name and contact information, address and telephone number of local suppliers of factory representative.
            c) Lubrication and maintenance instructions and recommended service maintenance schedule for all equipment including all electric motors. Sample maintenance record forms for each equipment type.
            d) A lubrication chart listing each item of equipment, all points of lubrication, proper lubricant, dates lubricated, and lubrication schedule.
            e) Belt sizes, types and lengths – adjustments made to install systems.

4) Data sheets to show model number, capacity, nameplate data, complete internal wiring, mechanical and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or electrical failure, and description of operating, test, adjustment, and maintenance procedures.
   a) Where data sheets included in the manual include equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
   b) Parts catalog references for each item of equipment furnished with components identified by number for replacement.
   c) Final submittals for equipment shall have final corrections included in the points used for the manual.
5) Testing and Balancing reports:
   a) Sheets detailing all set points, and final balance figures of air and water systems.
   b) Cross-reference diagrams in plan to identify air terminals and equipment location.
   c) NC levels by room
   d) Pressurization testing results (as applicable).

d. Section 4: Controls:
   1) Title index tabs identifying items therein.
   2) Detailed list of all sensors, devices, and controllers cross reference to control set points names. List shall cross reference physical location in building, control and wiring diagrams and documentation in this section.
   3) Software name/version and support contact information.
   4) Detailed description of sequence of operation of each system, with charts and diagrams. Include emergency operation performance and resetting procedures as appropriate. Include explicit definition of all setpoints, alarm triggers, loop tuning coefficients, and ranges present within programming at time of handover.
   5) Provide full size copies of Record one-line diagrams and plans, thin laminated and folded into plastic envelopes for inclusion in the binder.
   6) Provide laminated control diagrams. Diagrams shall show complete equipment, controls, model numbers, etc., marked to correspond to identification on equipment.
e. Section 5: Certifications:
   1) Title index tabs identifying items therein.
   2) Certificates: Submit final inspection certificates signed by governing authorities.
   3) Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
   4) Machinery vibration test reports.
   5) Room NC levels at handover as tested by an acoustical engineer.
   6) Test certificates.
   7) Instruction certificates.
   8) Inspection certificates.
   9) Fire Marshal and/or Fire Department approvals of system.
   10) Final inspection certificate signed by governing authorities.
   11) UL, ASME and ASTM rating certificates (as appropriate).
   12) Air Quality Management District certification of boilers.
   13) Other certification as noted in other Division 23 sections.
f. Section 6: Record As-Built Drawings: Submit drafts of service and maintenance instruction sheets to Owner’s Representative for review before preparing final sets.
g. Section 7: Video documentation of training sessions
h. Section 8: CD’s containing O&M Manual as electronic versions

1.10 WARRANTY

A. Conform to the requirements of Section 01 70 00 - Execution and Close Out Requirements and Warranties

B. Unless by the Contractor for the period referenced in 01 70 00. Each system

C. shall be free of defects of materials and workmanship, and shall perform satisfactory under all conditions of load or service. The warranties shall provide that all additional controls, protective devices or equipment provided as necessary to make the system or equipment operate satisfactorily and than any faulty materials or workmanship shall be replaced or repaired. On failure of the warrantor to do the above after written notice from Owner, the Owner shall have the Work done at the cost of the warrantor. Loss of refrigerant is considered a defect in workmanship and/or equipment, to be corrected at no extra cost to the Owner.

D. Provide new materials, equipment, apparatus and labor to replace that determined by Owner to be defective or faulty within the warranty period.

E. This guarantee also applies to services including Instructions, Testing, Adjusting, Balancing, Noise and Commissioning.

F. Furnish Manufacturers' standard Warranties in excess of the period referenced in Section 01 70 00, only as specifically required under the individual equipment section.

G. Unless otherwise noted, warranties shall commence upon the Owner's final acceptance of the project.

1.11 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

C. Nothing in these plans or specifications is to be construed to permit work not conforming to the prevailing codes and regulations. Should there be any direct conflict between any referenced standard and the governing code, the mandatory code language shall govern to set only the minimum requirements and the most stringent requirement shall govern. A letter or Request for Information (RFI) shall be generated to highlight the discrepancy.

D. Install Work by craftsmen skilled in the trade involved and by apprentices as indicated in the General Conditions.

E. The Contractor recognizes that the design is based upon the equipment and material specified by name or construction and the Contractor accepts full responsibility for assuring that the quality, utility and performance of a substitution equals or exceeds that of the specified item.

F. Electrical Testing: Provide the services of a qualified testing laboratory/agency to perform the specified field tests. Notify the Owner's Representative 24 hours in advance of performance of Work requiring testing. Provide all materials required for testing. Refer to Division 26 for detailed requirements of electrical testing.

G. Factory and Field Testing
   1. See each Section for the required testing and procedures.
   2. Provide the services of a qualified testing laboratory/agency to perform the specified field tests.
   3. Notify the owner's representative at least 72 hours in advance of tests.
   4. Provide all materials required for testing.
   5. Test reports shall include:
      a. Description of equipment tested.
      b. Description of test procedures.
      c. Test results.
      d. Names and signatures of witnesses of tests.

H. Performance testing

1. Upon completion of the Work and following adjustment of all equipment, conduct an operating test for each system's acceptance. Demonstrate all systems and equipment to be operational and free from all electrical and mechanical defects.
2. Notify the Owner’s Representative fourteen days in advance of when tests will be performed. At that time, provide a test procedure plan, test schedule and test procedure forms.
3. Coordinate the work of Performance Testing with the Commissioning Requirements for Pre-Functional and Functional Testing.

I. Any appliance for which there is an ASHRAE 90.1 standard established regarding appliance efficiency shall comply with the applicable standard.

J. Materials and Workmanship
1. Materials shall be new, meet detailed requirements of the contract document and be identifiable as being specified or substitute products. Materials shall be kept in original packing material and protected from the elements by plastic and placed on dunnage until the item is installed. Once installed, all electrical devices exposed interior materials and all insulation installed shall be covered with sealed plastic until the building is fully enclosed and all spraying applications are complete.
2. Materials that do not conform to the requirements of the contract documents, are not equal to approved samples or are unsatisfactory or unsuited to the purpose for which they are intended, will be rejected and shall not be installed.
3. All work shall be performed by properly licensed plumbers, mechanics, and technicians with work limited to their respective trades.
4. All equipment shall be installed in accordance with the recommendation of the manufacturer. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work.
5. Defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the Owner's Representative, and the work shall be re-executed by the Contractor. The fact that the Owner's Representative may have previously overlooked such defective work shall not constitute acceptance of it.
6. In no case shall a Bidder base his bid on a class of material or workmanship less than that required by the contract documents and the governing codes and ordinances.
7. Materials and adhesives used throughout the mechanical systems for insulation, filters, ducts, flexible connections and jackets or coverings regardless of kind for piping and ducting system components, shall have a flame spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. "Flame Spread Rating" and "Smoke Developed Rating" shall be as determined by the "method of test of surface burning characteristics of building materials, NFPA No. 244, ASTM E84, Underwriters Laboratories, Inc., Standard". Such materials are listed in the Underwriters Laboratories, Inc., "Building Materials List" under the heading "Hazard Classification (Fire)".
8. Equipment shall be approved for use by all relevant Authorities Having Jurisdiction, where applicable.
9. Equipment required to have test labels by requirements of individual equipment sections shall have labels permanently affixed.
10. Manufacturer’s nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. The nameplate of the Subcontractor or Distributor is not acceptable.

K. All Base Materials: Comply with standard ASTM and ANSI.

L. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply withstandards, ASME stamped.

M. All Electrical Devices and Wiring: Conform to standards of NEC. All devices: UL listed andidentified.

N. Applicator (Erector) Qualifications:

1. All equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
2. All equipment and accessories new, free from defects.
3. Supply all equipment and accessories in compliance with the applicable standards listed in this Section and with all applicable national, state and local codes.
4. All items of a given type shall be the product of the same manufacturer.
5. Electrical equipment: Listed by UL and bearing their label.

O. Checking and Testing Equipment By Contractors and Manufacturer's Representative
1. All equipment shall be installed per the manufacturer's instructions. During construction request supervisory assistance from equipment manufacturer's representatives so the equipment will be correctly installed. After installation, request the Owner's Representative to inspect and see the equipment is in proper working order.
2. Manufacturer's representative shall review the overall system design relative to the proper application of his equipment in the particular system. He shall note conduit, wiring, control, location, and other relevant relationships, and furnish appurtenances necessary for satisfactory operation.
3. Before equipment start up, the manufacturer's representative shall submit to the Owner's Representative, a signed statement certifying to their inspection and noting that the equipment is properly installed and ready for operation.

1.12 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.13 PROTECTION, DELIVERY, STORAGE, AND HANDLING

A. Conform to the requirements specified in Section 01 60 00 - Product Requirements.

B. Contractor to provide an authorized representative to constantly supervise Work of this Division,check all materials prior to installation for conformance with Drawings, Specifications, and reviewed Shop Drawings.

C. Delivery
1. Deliver materials or equipment to the Project in the manufacturer’s original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage, ingress of dirt or contamination of any kind. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.
2. Perform all handling and shipping in accordance with manufacturer's instructions.
3. All ductwork shall be delivered to site with all ends and openings capped with heavy gauge polythene sheeting taped all around to prevent ingress of moisture, dust, and debris.
4. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer’s recommendations. Provide protective coverings during construction.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

D. Identification
1. Identify materials and equipment delivered to Site to permit check against approved materials list, reviewed Shop Drawings. Identify materials and equipment by manufacturer’s name, tag reference and nameplate data. Remove unidentified materials, equipment from Site.

E. Loss or Damage
1. All materials, appliances, and equipment shall be new and free from defects, and of the make, brand or quality specified or as accepted by the Owner. All materials and equipment shall be installed in a neat and workmanlike manner. Any work not so installed shall be removed and replaced in a satisfactory manner at no charge to the Owner.
2. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new. Variance from this permitted only with written acceptance.

3. The Contractor shall replace lost or damaged materials and equipment with new at no increase in Contract Sum.

F. Storage
1. All stock-piled material shall be placed on pallets, and protected from weather and from entry of foreign material and construction dust by plastic. All stored materials and equipment shall be carefully inspected and cleaned prior to installation and replaced with new material or equipment if found to be damaged, corroded, etc.
2. Equipment which is observed to be exposed to the weather, dirt or construction debris can be interpreted by the Owner's Representative as defective equipment under this clause.
3. All stored materials and equipment shall be carefully inspected prior to installation and replaced with new material or equipment if found to be damaged or corroded.
4. Completely cover motors and other moving machinery to protect from dirt and water during construction, including after installation.
5. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.
6. Store plastic pipes protected from direct sunlight. Support pipe to prevent sagging and bending.
7. Protect all finished surfaces of fixtures and exposed to view materials with heavy plastic or by other means, throughout the period of construction.

G. Waterproof Construction
1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls, above grade walls, roofs, and floors. Provide membrane clamps at penetrations of waterproof membranes.
2. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rain water. This requirement applies to damper operations and bearing, damper motors, controls and instruments. See other paragraphs in this Division for application of this requirement to motors, drive, ducts and fans.

3. If ductwork, piping, insulation or any damper or valve is installed in a riser prior to the permanent roof construction of that riser is complete, provide auxiliary sheet metal, drain piping, and caulking to ensure watertight caps on all temporary riser top openings that occur during the construction process. Take responsibility to ensure that watertight protection is provided continuously except when actual work is being done at the opening.

1.14 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination, Field Engineering, Electrical Characteristics, Cutting and Patching.

B. Coordinate requirements for access panels and doors for HVAC items requiring access that areconcealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

C. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the Drawings and Specifications todetermine nature and extent of work specified in other Divisions that adjoins, shares space with,or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum headroom and clearance may be obtained. In the event that interferences develop, the Owner's Representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit or equipment to clear such interferences.

D. For Testing and Balancing of the system, ensure full co-ordination between the Testing andBalancing subcontractor and all other Trades to achieve access to all system components including leaving wall/ceiling sections down for access.

E. Coordination with Structural Work
   1. Schedule of Work: In accordance with Division 01 - General Requirements and as follows:
      a. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
      b. In scheduling, anticipate means of installing equipment through available openings in structure.
      c. Ascertain temporary openings required for admission of apparatus. Notify the General Contractor and Architect accordingly. Provide such openings at no additional cost to the Owner.
   2. Openings and penetrations are prohibited in structural members, except where shown or as directed by the Owner’s Representative and the building’s Structural Engineer in writing.
   3. At the start of the project, meet with the Owner’s Representative to obtain information regarding allowable sleeve or penetration spacing and size.
   4. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
   5. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
   6. The Contractor shall be responsible for being aware of the nature and arrangement of the materials and construction to which the work attaches or passes through, and shall propose support and penetration details that are consistent with maintaining the integrity and performance of the construction such as, but not limited to, fire-resistive construction, acoustically rated construction, vibrated isolated construction, water tight construction, fire proofed construction, and isolated construction.
   7. The Contractor shall do all cutting, sleeving, core drilling and carpentry of building materials, piping, etc., as required for the installation of work and in accordance with Section 01 73 29.
   8. All cutting shall be performed with machine saw. Holes for pipes in concrete walls or floors shall be drilled with core drilling equipment. Verify location of all such cutting or core-drilling with the structural engineer prior to execution.
   9. Where any Mechanical work cannot be installed as the work progresses, the Contractor shall provide and arrange for the building in of boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. This field coordination work shall be completed prior to structural shop drawings and shall follow the principles set forth in the meeting

reference above. Arrange for and lay out any chases, holes, or other openings that must be provided in masonry, concrete or other work.

10. This work shall be incorporated into the initial shop drawing review of the construction (wall, floor, etc.) that is affected so that the Owner's Representative may review the impact of the holes.
11. Once the structural shop drawings are returned with no exception taken, the contractor shall bear the cost of time and materials for the Owner's Representative to review the appropriateness of cutting or drilled holes in planned or existing construction.
12. The Contractor shall be responsible for ensuring that all openings shown on the drawings or otherwise required are provided by the relevant trade contractor during the construction of the wall or roof.
13. No structural members shall be cut without the prior approval of the Owner's Representative. To gain approval to cut concrete, X-ray the affected area (or use another non-destructive method to examine the affected area) and submit results to Structural Engineer for review. Submit to Owner's Representative, drawings and details for the support of structure around the opening. If the standard structural details are to be used, then submit a plan that cross-references all penetrations against detail numbers for review. Otherwise, submit drawings, design, and calculations stamped by a Registered Professional Structural Engineer in the state of Louisiana. Any cutting and remedial support shall be done in a manner satisfactory to the Owner's Representative.
14. Where openings break into an existing wall, the Contractor shall provide lintels as required for the support of building construction above the opening. Lintels shall be structural steel angles, channels or tees of proper size and sections for the supported load. The Contractor shall submit structural load calculations to the Owner's Representative signed and sealed by a professional engineer prior to installation.
15. The contractor shall bear the cost of time and materials for the Owner's Representative to re-analyze the construction if the original penetration spacing principles are not adhered to, for whatever reason.

F. Cutting And Patching
   1. Patching of building structure, walls, floors, etc. during normal work progress with Requirements of Section 01 33 00.
   2. All patching of or repair of damage to completed work in place shall be done to meet with the approval of the Owner's Representative.
   3. Work in place that is subsequently cut is seen as evidence of the contractor's lack of field coordination during the shop drawing production phase. Because field coordination is a requirement of the contract, the contractor must bear all costs of cutting, patching and repair for corrective work.
   4. Assume responsibility for damage to any part of premises or Work of other Divisions, caused by leaks or breaks in piping or equipment furnished or installed under this Division during construction and guarantee/warranty period.
   5. Provide sleeves, caps, plates, escutcheons, flashing, etc., required to fill or close the openings. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required. Make repairs in like and kind for exact patching or surfaces and finishes.
   6. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with Owner's Representative and municipal or other government bodies.
   7. All patching shall be equal to the condition of the element prior to cutting as defined by the Owner's Representative.

G. Coordination with Electrical Work
   1. Division 26 Contractor: Wire all mechanical equipment furnished by this Division (excluding internal factory wiring) in accordance with the following general provisions:
      a. Provide 120-volt emergency power circuits available at panel for control contractor's use.
      b. Provide and wire heavy-duty, quick-make, quick-break type disconnect switches, manual pushbuttons and other fire alarm hard-wiring specifically called for in the documents or noted in electrical specifications and wherever required by Code. This excludes factory-mounted disconnects on equipment.

c. Receive, unload, set, and rough align all separately shipped motors.
d. Receive, unload, set and install all motor starters and variable frequency drives, except those clearly specified as an integral piece supported on the body of a piece of equipment.
e. Wire all miscellaneous solenoid valves, relays and other components provided with equipment which is not factory wired or part of control contractor's scope.
f. Wire lighting controls and other monitoring systems for interface with Building Management and Control System.
g. Wire interlocks between equipment as called for in Controls specifications.
h. Provide final equipment power connections for all equipment with voltage 110-volt and greater, including overcurrent protection and disconnect.
i. Provide final equipment connections for all equipment that require motor starters. Include starter, overcurrent protection, and disconnect.
j. Provide final connection to motorized smoke and fire-smoke dampers with voltage 110-volt and greater.
k. Provide 120V wiring and conduit from dedicated J-box to Control Panels or controllers. Provide a disconnect switch for each final connection.

2. Division 23 shall provide the following:
   a. All motor starters and variable frequency drives or control devices called for to be factory prewired to mechanical equipment.
   b. All control devices noted on the drawings and within the specifications, including devices required to achieve Sequences of Operations but not explicitly mentioned or called out. Provide controls, controllers, relays, transformers, switches, etc. required by Work of this Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
   c. Complete and accurate wiring diagrams to Division 26 for all equipment requiring electrical power wiring.
   d. Information for separately shipped motors and variable frequency drives to be installed by Division 26. Adjustable motor bases and all bolts and nuts required for installation of base and motor shall be provided and installed by Division 23.
   e. Align and adjust mechanical coupling for direct-driven motorized equipment. Adjust and align drive and belt tension on belt-driven equipment.
   f. Field lubricate all motors prior to operation and maintain lubrication prior to acceptance of equipment by the Owner's Representative.
   g. Provide motor terminal connection diagram as prepared by motor manufacturers.
   h. Provide low- voltage (less than 100V) control wiring from Control Panel or controller to controlled device.
   i. Electrical work in this Division shall conform to the requirements of Division 26.
   j. Provide controls relay for Building Automation System’s position monitoring of motorized smoke and fire-smoke dampers (in coordination with Division 28).
   k. Equipment shall be ordered with factory-wired assemblies or panels, pre-wired to numbered terminal strips for connection to field wiring.
   l. Provide weather-proof devices or protection for equipment outdoors, regardless of installing party.
   m. Contractor to coordinate piping routing to ensure piping does not run above electrical equipment.
3. Division 28 Contractor: Wire all mechanical equipment furnished by this Division in accordance with the following provisions:
   a. Product of combustion (duct smoke) detectors to be furnished under Division 28. Damper and duct smoke detectors to be installed by Division 23. Duct smoke detector to be wired by Division 28 to the fire alarm system.
   b. Provide hard-wired air handling equipment shut-down relay connection as required by code.
   c. Provide hard-wired connections for smoke control systems.
   d. Provide hard-wired connections for control to all motorized smoke and fire-smoke dampers.
   e. Provide fire alarm system position-monitor wiring for all motorized smoke and fire- smoke dampers.

f. Provide Fire Alarm location signals to the Building Management System, as applicable.

4. Where Drawings clearly and explicitly differ from the preceding wiring paragraphs, Drawings have precedence.

H. Commissioning Responsibilities

1. Provide mechanical technical support and controls services to assist the Commissioning agent to manipulate the control system during Functional Testing.
2. Provide testing adjusting and balancing services to assist the Commissioning agent to provide diagnostic measurements during Functional Testing.

PART 2 PRODUCTS

2.01 GENERAL COMMENTS ON MATERIALS

A. Equipment specified by manufacturer's number shall include all accessories, controls, etc., listed in catalog as standard with equipment. Furnish optional or additional accessories as specified.

B. Where no specific make of material or equipment is mentioned in the construction documents, an RFI shall be submitted suggesting any first class product of reputable manufacturer selected at the Contractor's discretion, provided it conforms to requirements of system.

C. All items of materials in each category of equipment shall be of one manufacturer.

D. Equipment shall be as described in the respective Sections of Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) and as shown.

E. Design of mechanical systems is generally based on the product of one of the manufacturers cited. Where systems for product installed necessitate modification of systems shown on plans, Contractor is responsible for installation of systems appropriate to product installed.

2.02 MANUFACTURERS

A. In other Division 23 specifications, the following applies in Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements and manufacturer's offerings, products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements and manufacturer's offerings, products that may be incorporated into the Work include, but are not limited to, manufacturers specified

PART 3 EXECUTION

3.01 LOCAL AND EXISTING CONDITIONS

A. Prior to bidding, visit the site and determine all existing conditions affecting work in this Division and make adequate provisions in the bid proposal. Examine all Drawings and Specifications to familiarize with the type of construction to be used, and the nature and extent of work of other trades.

B. Observe the conditions under which deliveries of materials and equipment shall be made and under which such materials and equipment can be stored, and shall include adequate provision in the bid proposal.

C. Anticipate means of installing equipment through available openings in structure and make adequate provisions in the bid.

D. The location and elevation of the utilities, existing ductwork, piping, conduit, or equipment is that which can be determined from available information and its accuracy cannot be guaranteed. Exact location and elevation of these items shall be verified by the Contractor prior to excavation, demolition, or installation of any portion of the work indicated. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to the utility services, as well as to ensure worker safety. Protect existing active services (water, gas,sewer, electric) when encountered, against damage from construction work. Do not prevent or disturb operation of active services which are to remain.

E. Any connections to or relocation of any existing utility line requiring temporary discontinuance of utility services which are in active use shall be scheduled and coordinated with the utility companies and the Owner's Representative at least 10 working days in advance. Provide description of disconnect, procedure to be done, and date/time duration of shutdown. The Work may require shutdowns to be

accomplished on an “overtime” basis without additional cost to the Owner. Arrange work for continuous performance to assure that existing operating services will be shut down only during the time required to make necessary connections. If a system cannot shut down, install temporary bypasses or jumpers until connections are complete. In no case shall the services be left disconnected at the end of a working day or weekend unless authorized by representatives of the utilities and the Owner’s Representative. Any existing utility service damaged shall be repaired to the satisfaction of the Owner's Representative.

F. If existing active utility services are encountered which require relocation, make request proper authorities for determination of procedures. Properly terminate existing services to be abandoned in conformance with requirements of authorities having jurisdiction.

G. All removed equipment shall remain the property of the Owner and stored on site as directed.

H. Where connections or disruptions are made to existing system, reactive, refill and recharge all components and restore systems to the same operating conditions prior to the time of disruption.

I. Equipment Rough-In:
   1. Rough-in locations shown on Mechanical Drawings for equipment furnished by Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources:
      a. From Shop Drawings for Contractor furnished and installed equipment.
      b. From Architect for Owner furnished-Contractor installed equipment
      c. From existing equipment where such equipment is relocated under this Contract
   2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.
   3. Make final connections.

3.02 FIELD VERIFICATION

A. All dimensions, locations of equipment and connections to utilities or pre-existing equipment shall be verified in field prior to construction and installation.

B. Architectural plans will hold precedence over mechanical plans as to location of partitions and diffusers.

C. Measurements in existing buildings shall take precedence over all other plans with regards to identifying location of existing installations.

D. All roughing in construction dimensions shall be made from architectural plans where discrepancies may exist. No change orders will be allowed for shifts in mechanical piping, ductwork, or equipment to match rough-in hole locations within 10 feet of original mechanical drawings.

E. Mechanical plans shall take precedence over electrical and plumbing plans with regards to placement of mechanical equipment and layout of electrical and plumbing equipment within rooms designated as “mechanical rooms.”

3.03 HOIST, RIGGING, TRANSPORTATION AND SCAFFOLDING

A. Provide all scaffolding, staging, cribbing, tackle hoist and rigging necessary for placing all materials and equipment in their proper places in the project. All temporary work shall be removed from the premises when its use is no longer required.

B. Prior to placing equipment or scaffolding, the contractor shall provide written verification that the structure on which the load is imposed has sufficient strength to accommodate the point and/or line loads.

3.04 PREVENTION AND RESTORATION OF DAMAGE

A. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.

B. Perform Work in manner precluding unnecessary fire hazard.

C. Repair and replace work installed by this Division when it becomes damaged.
   1. Wetted insulation shall be considered damaged.
   2. Any NEM1 or NEMA2 motors for actuators that is wetted shall be considered damaged.

3. Any metal showing evidence of rust, white rust, or other corrosion shall be considered damaged.
4. Any caulking or adhesive which is observed to be flaking, delaminating or otherwise appearing to lose its bond shall be considered to be damaged, even if no evidence of actual leakage is as yet available.
5. Any device or material exposed to fire or fire-generated smoke shall be considered damaged. This excludes localized use of controlled welding equipment for installation.
6. Any device or material not in compliance with the Construction Documents shall be considered damaged.
7. Ductwork, insulation and piping which shows evidence of denting, bending or compression greater than 1/8" deep shall be considered to be damaged. Any of these items showing evidence of having walked on will be considered damaged with replacement of the affected part and a 10' length on either side of the main damaged area.

D. Repair or replace, as directed by Owner's Representative, materials and parts of the Owner's premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.

E. Contractor shall be responsible for repair to work of all other Divisions caused by installation of the work of Division 23 or by leaks from piping or equipment furnished or installed under Division 23 during construction and guarantee/warranty period.

F. Where damage to another trades work occurs the Contractor shall pay the relevant trade contractor to make the repairs.

G. All repairs shall be equal to the condition of the element prior to cutting as defined by the Owner's Representative.

H. Review of Construction
1. Work may be reviewed at any time by the Owner's Representative.
2. Advise the Owner's Representative that work is ready for review at following times:
   a. Prior to backfilling buried work
   b. Prior to concealment of work in walls and above ceilings.
   c. When an area or section of work is ready for punchlisting by the Owner's Representative.
   d. When all requirements of Contract have been completed.
3. Maintain on job a set of Specifications and Drawings for use by Owner's Representatives.
4. The Owner's Representative will provide field observations of construction, will inform the Owner regarding progress and problems related to construction, and will endeavor to guard the Owner against defective materials and faulty workmanship. Field observations will be periodic depending upon nature of construction. The Owner's Representative does not perform an extensive or continuous inspection, is not responsible for execution of Contract Documents by Contractor, and is not responsible for construction methods, sequences, or safety precautions.

3.05 TOOLS AND EQUIPMENT

A. Furnish all tools and equipment necessary for the proper installation, protection and upkeep of the work.

B. Furnish to Owner the following:
1. One set of any special tools required to operate, adjust, dismantle or repair any equipment of this Division. "Special Tools" means those not normally found in possession of mechanics or maintenance personnel.
2. One pressure grease gun for each type of grease required, complete with adaptors to fit all lubricating fittings on equipment.

3.06 EXCAVATION, TRENCHING AND BACKFILL

A. Coordinate trenching and backfill required for the installation of this Division as detailed in Section 31 23 16 and 31 23 17. Repair or replace all street, roadway, sidewalk, pavements, gutters, curbs and other work incidental thereto. Dispose of excavation material per Division 31.

B. Provide barricades, signs, lanterns, shoring, sheeting and pumping as part of Work in this Division as required to insure safe conditions. Comply with OSHA requirements.

C. Shore all trenches and excavations as necessary to maintain the banks of excavations and to prevent any sloughing, caving-in or damage of any kind.

D. Perform all excavations, trenching, and backfill required to complete the work in this Division, regardless of the character of the materials encountered or the method of excavation required.

E. All excavations shall be inspected by the Owner's Representative and approved before placing of any pipe, conduit or duct.

F. Subject to the requirements of the civil engineer, dig trenches straight, true to line and grade with sides and bottoms smoothed of any rock points. Excavate 6 inches below grade of pipe, fill with sand properly packed. Support pipe for entire length on packed sand. Shape of pack bottom of trenches for pipe, duct fittings, hubs, couplings, etc., using templates to fit outside periphery of lower third of piping and ductwork. Provide piping outside building with 36 inch minimum cover from top of pipe to finished grade. Minimum width 16 inches.

G. All pipe, duct or conduit installation shall be inspected by the Owner’s Representative and the Authority Having Jurisdiction prior to backfill.

H. Pumping equipment shall be provided as necessary to keep trenches free from standing water. All shoring necessary to maintain the banks of excavations and to prevent any sloughing or caving-in, and as necessary to prevent damage of any kind which may occur in connection with this work shall be furnished and installed by the Contractor.

I. In any asphalt or concrete paved areas, backfill only to subgrade level, as coordinated with Division 31 Contractor.

J. Utility trenching shall comply with individual utility company requirements.

K. Any imported backfill material required shall be approved by the soils engineer responsible for certification of compaction.

3.07 INSTALLATION

A. Install equipment according to the manufacturer’s instructions, code requirements, and required access clearances.

B. Equipment Installation
   1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
   2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
   3. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
   4. Install equipment to allow right of way for piping installed at required slope.
   5. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturer’s agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.
   6. Accurately set and level with supports neatly placed and properly fastened. Properly fasten equipment in place with bolts to prevent movement in earthquake. No allowance of any kind will be made for negligence on part of Contractor to forsee means of bringing in, installing equipment into position inside building.

C. Vibration and Seismic Control
   1. Coordinate with Division 1.
   2. Design criteria and extent of bracing, anchorage, etc., for all the Work of Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) are specified in Section 23 05 48 - Vibration Controls for HVAC.

D. Hangers, Inserts, Supports and Bases

1. Provide required structural members, hangers, supports and inserts to keep piping and conduit in proper alignment and prevent transmission of injurious thrusts and vibrations. Where supported from concrete construction, do not weaken concrete or post-tension strands or penetrate waterproofing. Hangers and supports shall be finally adjusted in vertical and horizontal direction under operating conditions.
2. Metal deck roof systems shall not be used for the support of hangers, inserts, etc.
3. Support equipment and other mechanical items on curbs, legs or steel framework. Provide all metal bases and supports, not part of the building structure, unless specifically indicated to be provided under this Division shall be as described for similar work under other Division. Materials and equipment furnished or provided under this Division shall be as described for similar work under other Division. Concrete, masonry and wood bases and supports shall be provided under other division of this Specification. Furnish required
4. foundation sizes, bolts, washers, sleeves, plates, templates, etc., for mechanical equipment provided.
5. Coordinate inserts with Division 3 prior to pouring of concrete. In the infrequent event that an insert is dislodged or misplaced, provide a request for information that includes a precisely dimensioned drawing and a ferroscan of that area for Owner's Representative to review for potential expansion anchor drill locations.

E. Equipment Rough-In
1. Rough-in locations shown on Mechanical Drawings for equipment furnished by Owner and for equipment furnished under other Divisions are approximate only. Obtain exact rough-in locations from following sources:
   a. From Shop Drawings for Contractor furnished and installed equipment.
   b. From Architect for Owner furnished-Contractor installed equipment.
   c. From existing equipment where such equipment is relocated under this Contract.
2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on Drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.
3. Make final connections.

F. Concrete Pad
1. Anchor equipment to concrete pad according to equipment manufacturer's written instructions and according to seismic codes at Project.
2. Construct concrete pads of dimensions indicated, but not less than 4 inches (100 mm) high and extending 6 inches (150mm) beyond edge of the supported unit.
3. 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 the base.
4. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.
7. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
8. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement.

G. Rooftop Equipment Supports
1. Provide leak proof equipment supports for all roof mounted equipment that does not come with an adequate curb and supports supplied.
2. Supports shall be prefabricated of continuous welded 18 gauge minimum galvanized steel, 12 inch minimum height, mitered corner seams, integral cant and base plate, 2 inch by 4 inch fire resistant treated wood nailer, or 18 gauge counter flashing. Provide integral internal reinforcing necessary to support imposed load, but no less than 600 pounds per linear foot of perimeter.
3. Top surface of equipment shall be level. Provide base or special curbs where installed on pitched roof.

4. Install all roof piping on supports, by Pate, Stiles or equal and approved.
5. Provide equipment support extension legs, galvanized and painted for use with pitch pockets.

H. Roof openings & curbs
1. All roof openings shall include sleeves and be finished with a watertight pre-fabricated roof curb.
2. Roof curbs shall be RPS, Pate Corp. or equal. Curbs shall have acrylic-coated ABS rib- reinforced plastic curb covers and EPDM protection rubber caps, complete with stainless steel snap-lock swivel clamps.
3. Counter flashing shall be required on curbed openings and shall be 16 ounce CRC, except where counter flashing is a component part of equipment. See Division 7 for details of flashing.

I. Grout
1. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   a. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   b. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
2. Packaging: Premixed and factory packaged.
3. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
   a. Clean surfaces that will come into contact with grout.
   b. Provide forms as required for placement of grout.
   c. Avoid air entrapment during placement of grout.
   d. Place grout, completely filling equipment bases.
   e. Place grout on concrete bases and provide smooth bearing surface for equipment.
   f. Place grout around anchors.
   g. Cure placed grout.

J. Access Panels
1. Place no valves, traps, controls, unions, dampers, coils, air distribution boxes, cleanouts, junction boxes, pull boxes, expansion joints, etc., in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in systems.
2. Furnish all access doors required for all items located above finished ceilings, ceiling breaks or extensions behind finished walls or below finished floor, even though access doors may not be shown with the documents of this Division. Mark each door with a hidden identification tag cross-referenced to a plan location to ease installation by others.
3. Furnish access door and panel types as specified under Section 08 31 13 - Access Doors and Frames, to ensure the same manufacturer for identical appearance and keying. Installation by Section 08 31 00 Contractor.
4. Sizes: 12 by 12 inches for easily accessible items within 6 inches behind walls; 18 by 18 inches where partial body access is required; 24 by 24 inches at ceilings or where entire body access is necessary.

K. All work shall be performed by licensed contractors skilled in their respective trades.

3.08 START UP AND FIELD ADJUSTMENT

A. Startup Service:
1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed properly set relief and safety valves.
2. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.

B. Contractor shall be responsible to change or adjust belts, drives, pulleys, motors, impellers, as required by balancing company to achieve the desired air and water delivery in an energy efficient manor by all air handling equipment, fans and pumps.

3.09 OPERATION BY OWNER

A. Owner may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by Owner.

B. Operation of installation shall not be construed as acceptance of Work.

3.10 TESTING

A. Labor, materials, instruments and power required for testing provided under respective Sections for Work under that Section. Test all systems as specified under various applicable Section. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.

B. Test shall be performed to the satisfaction of the Owner's Representative and regulating authority having jurisdiction. Submit written certificates that tests have been performed in accordance with Specification requirements.

C. Repair or replace defective Work and repeat tests until particular systems, and component parts thereof, receive approval of Architect and regulating authority. Any damages resulting from tests shall be repaired and damaged material replaced, all satisfaction of Architect and at no cost to Owner

D. Tests shall be performed on individual equipment, systems and their controls. Whenever the equipment or system under test is inter-related with, and depends upon, the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operating simultaneously with equipment or system being tested.

E. Testing, adjusting and balancing of air and hydronic systems is specified under Section 23 05 93.

F. Pressure test piping before connection to equipment as required under Sections 23 21 13 and 23 22 13. No piping equipment or accessories shall be subjected to pressures exceeding their rating.

G. No piping shall be closed up, furred in, or covered before testing. Notify regulating authority and Owner's Representative with advanced notice as noted in Sections 23 21 13 and 23 22 13.

H. Drain water used for testing from the system after tests are complete. Repair or replace any damage caused by freezing of water left in system at no expense to the Owner.

I. Equipment and systems which normally operate during certain seasons of year shall be tested during the appropriate season.

J. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance. If, in the opinion of the Architect, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. Contractor, at his opinion, may order tests from an independent approved laboratory to prove compliance. Allsuch tests shall be at no increase in Contract Sum. Repeat process as often as required.

K. At completion of Work, provide written certification that all systems are functioning properly without defects.

3.11 PAINTING

A. All unpainted, non-insulated, non-galvanized, ferrous metal surfaces of pipes, equipment, fixtures, hangers, supports, and accessories painted under Section 09 90 00 - Painting and Coating.

B. Properly prepare Work under this Division to be finish painted under Section 09 90 00 - Painting and Coating.

C. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.

D. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials.

E. Provide colors as directed by Architect unless specified otherwise.

F. Provide factory finishes as noted in the individual Equipment Sections.

3.12 CLEANING

A. At all times keep the premises free from accumulation of waste material and debris caused by his employees. At the completion of the project, and at other times as Architect may direct, remove refuse from within and around the building. All tools, scaffolding and surplus materials shall also be removed, leaving the Site of his Work clean.

B. The Work of each Section includes removing tools, scaffolding, surplus materials, barricades, temporary walks, debris and rubbish from the Project promptly upon completion of that portion of the Work. Leave the area of operations completely clean and free of these items.

C. Clean premises of all excess construction material and debris caused by work, in accordance with Section 01 70 00.

D. Disconnect, clean and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.

E. Clean ductwork inside and out before grilles are installed and before fans are operated.

F. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish unless otherwise specified.

G. Clean exterior of piping, ductwork and equipment, exposed in complete structure. Remove rust, paint overspray, fireproofing overspray, plaster and dirt by wire brushing; remove grease, oil and similar materials by wiping with clean rags and suitable solvents.

H. Motors, Pumps, Air Moving Equipment and Other Items with Factory Finish: Remove grease, oil, paint overspray, fireproofing overspray, gypsum board mudsplatters and leave surfaces clean.

3.13 LUBRICATION

A. Lubricate all equipment at completion of Work. Furnish Owner with a written lubrication schedule for all equipment as specified in Section 01 78 00 - Closeout Submittals.

B. Extend grease fittings on all bearings to points of ready and easy accessibility.

C. Lubricate, as required, all motor and fan bearings, etc., before operation of any equipment.

D. Provide a final lubrication to all equipment requiring same immediately before turning over to Owner.

3.14 FINAL INSPECTION

A. The Contractor shall arrange for the all AHJ’s to make final inspections and correct all defects identified.

B. Prior to substantial completion the Contractor shall verify that the work is complete and that all incidental defects identified by the Architect/Engineer during construction have been corrected.

C. As the work nears completion, review the requirements of the Contract Documents, inspect the work and inform all parties involved in work to be corrected or completed before the project can be deemed substantially complete.

D. When the project is substantially complete, notify the Owner's Representative in writing of this fact, listing those items of work remaining incomplete, the reason for incompleteness, and the anticipated date that all remaining work will be completed. Carry out own final inspection and be satisfied that the work is complete. Final inspection of the project will then be scheduled by the Owner's Representative.

E. The Owner's Representative reserves the right to cancel and reschedule the inspection in the event considerable more work remains to be completed or corrected than indicated in the written request for inspection.

F. All items not completed or found not complying with drawings or specifications by the Owner's Representative will be identified in an inspection report by Owner's Representative

G. Correct all items on inspection report. Make the correction and initial and date each item on the report after corrections have been completed.

H. Verify that all defective work has been corrected before offering the system for re-inspection.

3.15 PROJECT CLOSE-OUT

A. Prior to requesting Owner's Representative's inspection for certification of substantial completion, complete the following and list known exceptions in request:
   1. Obtain final inspections and approvals from all governmental jurisdictions that are required for the project.
   2. Submit record drawings, maintenance manuals, warranties, and similar final record information.
   3. Deliver tools, spare parts, extra stocks of materials, and similar physical items to the Owner.
   4. Complete start-up, testing and demonstration of systems to the satisfaction of the Owner's Representative that the entire installation is complete, properly adjusted and is in proper operating condition.
   5. Complete final cleaning requirements.
   6. Complete all training requirements for Owner’s Staff.

END OF SECTION 23 05 00

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: Class B.

H. Code Letter Designation:
   1. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

2.04 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.06 VARIABLE FREQUENCY DRIVES

A. Manufacturers: ABB or approved equivalent.

B. The drive package as specified herein and defined on the drive schedule shall be enclosed in a UL Type enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer to ISO9001 standards.
1. The drive shall provide full rated output from a line of +10% to -15% of nominal voltage. The drive shall continue to operate without faulting from a line of +25% to -35% of nominal voltage.
2. Drives shall be capable of continuous full load operation under the following environmental operating conditions:
a. Ambient temperature -15 to 40° C (5 to 104° F).
b. Altitude 0 to 1000 m (0 to 3,300 ft) above sea level.
c. Humidity 5 to 95%, non-condensing.

C. All drives shall utilize the same Advanced Control Panel (keypad) user interface.
1. Plain English Text
a. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).
b. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure.
c. Safety interlock, run permissive, Supervisory, external fault status, drive name, drive fault contact info and override shall have the option of additional customized project specific terms, such as: AHU-1 End Switch, Office Smoke Alarm, CT-2 Vibration.
2. The control panel shall include at minimum the followings controls:
a. Four navigation keys (Up, Down, Left, Right) and two soft keys to simplify operation and programming.
b. Hand-Off-Auto selections and manual speed control without having to navigate to a parameter.
c. Fault Reset and Help keys. The Help key shall include assistance for programming and troubleshooting.
3. Multiple Home View screens shall be capable of displaying up to 21 points of information. Customizable modules shall include bar charts, graphs, meters, and data lists. Displays

shall provide real time graphical trending of output power, frequency, and current within selectable intervals of 15/30/60 minutes and 24 hours.

4. **The control panel shall display the following items on a single screen; output frequency, output current, reference signal, drive name, time, and operating mode (Hand vs Auto, Run vs Stop). Bi-color (red/green) status LED shall be included. Drive (equipment) name shall be customizable.**
5. **There shall be a built-in time clock in the control panel. The clock shall have a battery backup with 10 years minimum life span. Daylight savings time shall be selectable.**
6. **I/O Summary display with a single screen shall indicate and provide:**
   a. **The status/values of all analog inputs, analog outputs, digital inputs, and relay outputs. Drives that require access to internal or live components to measure these values, are not acceptable.**
   b. **The programmed function of all analog inputs, analog outputs, digital inputs, and relay outputs.**
   c. **The ability to force individual digital I/O high or low and individual analog I/O to desired value, for increased personal protection during drive commissioning and troubleshooting. Drives that require access to internal or live components to perform these functions, are not acceptable.**
7. **The drive shall automatically backup parameters to the control panel. In addition to the automatic backup, the drive shall allow two additional unique backup parameter sets to be stored. Backup files shall include a time and date stamp. In the event of a drive failure, the control panel of the original drive can be installed on the replacement drive, and parameters from that control panel can be downloaded into the replacement drive.**
8. **The control panel shall display local technical support contact information as part of drive fault status.**
9. **The control panel shall be removable, capable of remote mounting.**
10. **The control panel shall have the ability to store screen shots, which are downloadable via USB.**
11. **The drive shall generate a QR code, which contains drive identification data, information on the latest events, and values of status and counter parameters.**
12. **The LCD screen shall be backlit with the ability to adjust the screen brightness and contrast, with inverted contrast mode. A user-selectable timer shall dim the display and save power when not in use.**
13. **The control panel shall include assistants specifically designed to facilitate start-up. Assistants shall include: First Start Assistant, Basic Operation, Basic Control, and PID Assistant.**
14. **Primary settings for HVAC shall provide quick set-up without the use of alpha-numerical parameters, for commissioning the drive and customer interfaces to reduce programming time.**
15. **The drive shall be able to operate with the control panel removed.**
16. **The drive shall be able to support a Bluetooth Advanced Control Panel. The Bluetooth control panel shall be FCC and QDL (Qualified Design Listing) certified.**
    a. **A free app (iOS and Android) shall replicate the control panel on a mobile device or tablet. The control panel's programming and control functionality shall function on the device. Customizing text, such as AHU-1 End Switch, shall be supported by the device's keyboard.**
    b. **Bluetooth connectivity shall allow uploading, downloading, and emailing of parameter sets.**
    c. **Bluetooth connectivity shall include two pairing modes: Always discoverable with a fixed passcode, and manual discovery with a unique generated passcode every pairing.**
    d. **Bluetooth connectivity shall be capable of being switched.**

D. All drives shall have the following hardware features/characteristics as standard:

1. **Voltage selection configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.**
2. **Two (2) programmable analog outputs. At least one of the analog outputs shall be adjustable for current or voltage signal, configured via control panel. Drives that require access to internal components to perform these functions, are not acceptable.**
3. **Six (6) programmable digital inputs. All digital inputs shall be programmable to support both active high and active low logic, and shall include adjustable on/off time delays. The digital input shall be capable of accepting both 24 VDC and 24 VAC.**
4. **Three (3) programmable Form-C relay outputs. The relay outputs shall include programmable on/off time delays. The relays shall be rated for a continuous current rating of 2 Amps. Maximum switching voltage of 250 VAC / 30 VDC. Open collector and Form-A relays are not acceptable. Drives that have less than (3) Form-C relay outputs shall provide an option card to provide additional relay outputs.**
5. **Drive terminal blocks shall be color coded for easy identification of function.**
6. **The drive shall include an isolated USB port for interface between the drive and a laptop. A non-isolated USB port is not acceptable.**
7. **An auxiliary power supply rated at 24 VDC, 250 mA shall be included.**
8. **At a minimum, the drives shall have internal impedance equivalent to 5% to reduce the harmonics to the power line. 5% impedance may be from dual (positive and negative DC link) chokes, or AC line reactor. Drives with only one DC link choke shall add an AC line choke integral to the drive enclosure. Reference the drive schedule to determine if additional harmonic mitigation is required for the system to comply with IEEE 519-2014.**
9. **The drive shall have cooling fans that are designed for field replacement. The primary cooling fan shall operate only when required and be variable speed for increased longevity and lower noise levels. Drives whose primary cooling fans are not variable speed, shall include a spare cooling fan.**
10. **The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 135% overload for 2 seconds every minute. The minimum current rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.**
11. **The input current rating of the drive shall not be greater than the output current rating. Per NFPA 70 430.122, drives with higher input current ratings may require the upstream wiring, protection devices, and source transformers to be upsized.**
12. **Circuit boards shall be coated per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.**
13. **Earth (ground) fault detection shall function in both modulating (running) and non-modulating modes.**
14. **Coordinated AC transient surge protection system consisting of 4 MOVs (phase-to-phase and phase-to-ground), a capacitor clamp, and internal chokes. The MOVs shall comply with UL 1449 4th Edition. Drives that do not include coordinated AC transient surge protection shall include an external TVSS/SPD (Transient Voltage Surge Suppressor/Surge Protection Device).**
15. **The drive shall include a robust DC bus to provide short term power-loss ride through. The DC bus Joule to drive kVA ratio shall be 4.5 J/kVA or higher. An inertia-based ride through function should help maintain the DC bus voltage during power loss events. Drives with control power ride through only, are not acceptable.**

E. All drives shall have the following software features as standard:

1. **A Fault Logger that stores the last 16 faults in non-volatile memory.**
   a. **The most recent 5 faults save at least 9 data points, including but not limited to: Time/date, frequency, DC bus voltage, motor current, DI status, temperature, and status words.**

b. The date and time of each fault and fault reset attempt shall be stored in the Fault Logger.

2. An Event Logger that stores the last 16 warnings or events that occurred, in non-volatile memory.
   a. Events shall include, but not limited to: Warning messages, checksum mismatch, run permissive open, start interlock open, automatic reset of a fault, power applied, auto start command, auto stop command, modulating started, and modulating stopped.
   b. The date and time of each event's start and completion points shall be stored in the Event Logger.
   c. The drive shall also provide the user the ability to configure what events to log for application specific requirements.
3. Programmable start method. Start method shall be selectable based on the application and function even if the motor was freewheeling in the reverse direction: Flying-start, Normal-start, and Brake-on-start.
4. Programmable loss-of-load (broken belt / coupling) indication. Indication shall be selectable as a control panel warning, relay output, or over network communications. This function to include a programmable time delay to eliminate false loss-of-load indications.
5. The following three-phase AC motor technologies shall be compatible:
   a. Asynchronous induction motors
   b. Permanent magnet synchronous (non-salient pole) motor
   c. Synchronous reluctance motor (SynRM)
   d. Permanent magnet assisted synchronous reluctance motor (PMaSynRM)
6. Motor heating function to prevent condensation build up in the motor. Motor heating adjustment, via parameter, shall be in "Watts." Heating functions based only on "percent current" are not acceptable.
7. Motor disconnect detection function enables the drive to detect when an output disconnect is opened, disable the drive output, and provide an indication message. Drives without this functionality shall have a disconnect switch auxiliary contact wired through dedicated conduit back to the drive enable control circuit.
8. Motor phase order shall be changeable through software interface
9. Advanced power metering abilities shall be included in the drive and must be available over network communications. Drives without these data points, must include a separate power meter with each drive.
   a. Instantaneous output power (kW)
   b. Total power, broken down by kWh, MWh, and GWh units of measurement. Power meters that only display kWh and roll over or "max out" once the maximum kWh value is reached, are not acceptable. There shall be resettable and non-resettable total power meters within the drive.
   c. Time based kWh metering for: current hour, previous hour, current day, and previous day.
   d. Energy saving calculation shall be included that shows the energy and dollars saved by the drive.
10. The drive shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise.
11. DC bus voltage ripple function shall provide a DC voltage reference for troubleshooting AC line issues or bus capacitor health
12. Run permissive circuit - There shall be a run permissive circuit for damper control. The drive shall provide a relay output to the damper actuator, monitor end-switch status, and

start running the motor based on application requirements. Damper control shall include the following configurable features fully functional in both Hand and Auto modes:

a. A timeout function that identifies and annunciates a specific warning message when a damper has not opened or closed within the allotted time.

b. Ability to interface with both damper open and damper closed end-switches on a single damper actuator.

c. Sequence control that runs the fan initially at a fixed speed before commanding a discharge air damper to open. Required for all applications feeding a common plenum/space to prevent the fan from freewheeling backwards while damper strokes open.

d. Multiple damper sequence control to support units with discharge air and outside air dampers. The drive shall command and verify the outside air damper is open before ramping the fan to a fixed speed, and then commanding the outside air damper open.

e. Time based damper control for when an end-switch is not provided. For units with outside air and discharge air dampers, both dampers should have independent time based control capability.

13. Start interlock circuit - Four separate start interlock (safety) inputs shall be provided. When any safety is opened, the motor shall be commanded to stop. The control panel will display the specific safety(s) that are open. The status of each safety shall be transmitted over the network communications. Wiring multiple safeties in series is not acceptable.

14. External fault circuit – Three separate external fault inputs shall be provided. This circuit shall have the same features and functionality as the start interlock circuit, except it shall require a manual reset before the drive is allowed to operate the motor.

15. The drive shall provide automatic protections to allow uninterrupted operations at a reduced speed or switching frequency.

    a. Switching frequency control circuit, that reduces the switching frequency based on actual drive temperature and allows higher switching frequency settings without derating the drive. It shall be possible to set a minimum and a target switching frequency.

    b. The drive shall include a temperature limit that when exceeded will reduce the drive output current.

    c. Input phase loss protection shall be provided, whereas the output current is automatically derated by 50% if an input phase loss is detected by the drive.

16. Visual function block adaptive programming allowing custom control schemes, minimizing the need for external controllers.A free software tool shall be used to configure adaptive programming.

17. The ability to automatically restart after an over-current, over-voltage, under-voltage, external fault, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable. Each of these faults may have automatic restart individually disabled via a parameter selection.

18. Three (3) programmable critical frequency lockout ranges to prevent the drive from operating the load continuously at an unstable speed/load.

19. The drive shall have three methods to control constant frequency/speed references:

    a. Seven (7) programmable preset frequencies/speeds using (3) inputs.

    b. Six (6) different programable preset frequencies/speed tied to 6 independent control inputs and requires an additional start command.

    c. Six (6) different programable preset frequencies/speed tied to 6 independent control inputs and does not require any additional start command input.

20. Two independently adjustable accel and decel ramps sets with 1 – 1800 seconds adjustable time ramps.

21. PID functionality shall be included in the drive.

a. Programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped based on the level of a process feedback signal.

b. The drive shall include an independent PID loop for customer use, assigned to an Analog Output.

22. At least 4 parameter user sets that can be saved to the permanent memory and recalled using a digital input, timed function, or supervision function.

23. Drive shall be compatible with an accessory that allows the control board to be powered from an external 24 VDC/VAC source, allowing the drive control to remain powered by a UPS during an extended power outage.

24. A computer-based software tool shall be available to allow a laptop to program the drive. The drive shall be able to support programming without the need for line voltage. All necessary power shall be sourced via the laptop USB port.

25. The drive shall include a fireman’s override mode. Upon receipt of a contact closure from the Fire Alarm Life Safety system, the drive shall operate in a dedicated Override mode distinct and separate from the drive’s Normal operation mode. The following features will be available in the drive override function.

a. The Override mode shall be secured by passcode to prevent changes once programmed.

b. The drive shall ignore external inputs and commands not defined as part of the override function.

c. Override operation mode shall be selectable between: single frequency, multiple fixed frequencies, follow an analog input signal, PID control, or come to a forced stop.

d. High priority safeties shall stop the drive and lower priority safeties shall be ignored in Override mode.

e. Drive faults shall be defined in Critical and Low priority groups. Critical faults shall stop the drive. Low priority faults shall be reset. Reset trials and timing shall be programmable.

f. The drive shall be configurable to receive from 1 to 3 discrete digital input signals and operate at up to three discrete speeds.

F. Security Features

1. The drive manufacture shall clearly define cybersecurity capabilities for their products.

2. The drive shall include passcode protection against parameter changes.

a. There shall be multiple levels of passcode protection including: End User, Service, Advanced, and Override.

b. The drive shall support a customer generated unique passcode between 0 and 99,999,999.

c. The drive shall log an event whenever the drive passcode has been entered.

d. The drive shall provide a security selection that prevents any “back door” entry. This selection even prevents the drive manufacturer from being able to bypass the security of that drive.

e. A security level shall be available that prevents the drive from being flashed with new firmware.

3. A checksum feature shall be used to notify the owner of unauthorized parameter changes made to the drive. The checksum feature includes two unique values assigned to a specific programming configuration.

a. One checksum value shall represent all user editable parameters in the drive except communication setup parameters. A second checksum value shall represent all user editable parameters except communication setup, energy, and motor data parameters.

b. Once the drive has been commissioned the two values can be independently saved in the drive.

c. The drive shall be configurable to either: Log an Event, provide a Warning, or Fault upon a parameter change when the current checksum value does not equal the saved checksum value.

4. The "Hand" and "Off" control panel buttons shall have the option to do the following:

a. Be individually disabled (via parameter) for drives mounted in public areas to prevent unauthorized changes.

b. Require a second button press of "Hand" or "Off" within 5 seconds of the original selection to confirm the change and prevent accidental transition out of "Auto" mode.

G. Network Communications

1. The drive shall have an EIA-485 port with removable terminal blocks. The onboard protocols shall be BACnet MS/TP, Modbus, and Johnson Controls N2. Optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, EtherNet/IP, Modbus TCP, and DeviceNet shall be available. The use of third party gateways are not acceptable.

2. The drive shall have independent end of line (EOL) termination and biasing switches for EIA-485 networks.

3. The drive shall contain EIA-485 network self-diagnostics to assist in troubleshooting issues such as incorrect polarity, incorrect baud rate, noise on the wire or addressing errors

4. The drive shall have the ability to communicate via two protocols at the same time, one onboard protocol and one option card based protocol. Once installed, the drive shall automatically recognize any optional communication cards without the need for additional programming.

5. The drive shall not require a power cycle after communication parameters have been updated.

6. The embedded BACnet connection shall be a MS/TP interface. The drive shall be BTL Listed to Revision 14 or later. Use of non-BTL Listed drives are not acceptable.

7. The drive shall be classified as an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:

a. Data Sharing: Read Property Multiple-B, Write Property Multiple-B, COV-B

b. Device Management: Time Synchronization-B

c. Object Type Support: MSV, Loop

8. The drive's relay output status, digital input status, analog input/output values, Hand-Auto status, warning and fault information shall be capable of being monitored over the network. The drive's start/stop command, speed reference command, relay outputs and analog outputs shall be capable of being controlled over the network. Remote drive fault reset shall be possible.

H. Disconnect – A circuit breaker or disconnect switch shall be provided when indicated on the drive schedule. The disconnect shall be door interlocked and padlockable. Drive input fusing shall be included on all packaged units that include a disconnecting means. All disconnect configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508A label. Disconnect packages manufactured by anyone other than the drive manufacturer, are not acceptable.

I. Bypass – Bypass drive packages shall be provided when indicated on the drive schedule. All drive/bypass configurations shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL508A label. Bypasses manufactured by anyone other than the drive manufacturer, are not acceptable.

1. consisting of a padlockable disconnect device, drive output contactor, bypass contactor, and drive input fuses.

2. The drive and bypass package shall have a UL listed short circuit current rating of 100 kA, for 240 VAC and 480 VAC systems, and this rating shall be indicated on the rating label.
3. The bypass control shall be powered by a three-phase switch mode power supply with a voltage tolerance of +30%, -35%. Single-phase power supplies and control power transformers (CPT) are not acceptable.
4. The drive and bypass package shall be seismic certified and labeled to the IBC. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake table test data as defined by ICC AC-156. Seismic certification of equipment and components shall be provided by HCAI (formerly OSHPD) preapproval.
5. All bypass packages shall utilize a dedicated LCD bypass control panel (keypad) user interface. The bypass control panel must be a separate display from the drive control panel. Bypass packages that use a single shared drive/bypass control panel are not acceptable, due to that control panel acting as a single point of failure.
    a. The bypass shall include a two-line, 20-character LCD display. The display shall allow the user to access parameters and view:
        1) All three phases of the bypass input voltage, current (Amps) and power (kW)
        2) Bypass faults, warnings, and fault logs
        3) Bypass operating time and energy consumption (resettable)
    b. The bypass control panel shall include the following controls:
        1) Four navigation keys (Up, Down, Enter, Escape)
        2) Bypass Hand-Off-Auto, Drive mode / Bypass mode selectors, Bypass fault reset
    c. The following indicating lights (LED PTT type) or control panel display indications shall be provided.
        1) Drive mode selected, Bypass mode selected
        2) Drive running, Bypass running
        3) Drive fault, Bypass fault
    d. Safety interlock and run permissive status shall be displayed using predetermined application specific nomenclature, such as: Damper end switch, smoke alarm, vibration trip, and overpressure
6. All bypasses shall have the following hardware features/characteristics as standard:
    a. Six (6) digital inputs and five (5) Form-C relay outputs. The digital inputs shall be capable of accepting both 24 VDC and 24 VAC. The bypass control board shall include an auxiliary power supply rated 24 VDC, 250 mA.
    b. Drive isolation fuses shall be provided. Bypass designs which have no such fuses, or that only incorporate fuses common to both the drive and the bypass are not acceptable. Third contactor “isolation contactors” and service switches are not an acceptable alternative to drive isolation fuses.
    c. The bypass shall be able to detect a single-phase input power condition before the bypass contactor closes or while running the motor in bypass, by monitoring all three phases of input voltage. Relying on a high current trip if the motor is single-phased is not acceptable.
    d. The bypass shall be designed for stand-alone operation and be completely functional in both Hand and Automatic modes, even if the drive and/or drive’s control board has failed. Network communications shall remain functional. Bypass systems that do not maintain full functionality in the event of a drive failure, are not acceptable.
7. All bypasses shall have the following software features as standard:
    a. Programmable loss-of-load (broken belt / coupling) indication shall be functional in drive and bypass mode.
    b. The bypass shall also support run permissive and start interlock control functionality, including start delay, as previously specified in the drive section.

c. **The bypass control shall monitor the status of the drive and bypass contactors and indicate when there is a welded contactor contact or open contactor coil.**

d. **The bypass shall include a selection for either manual or automatic transfer to bypass. The automatic transfer mode shall allow the user to select the specific drive fault types that result in an automatic transfer to bypass. The automatic transfer mode shall not allow a transfer to bypass on motor related faults. Automatic transfer schemes that do not differentiate between fault types, are not acceptable.**

e. **The bypass shall include the ability to select the operating mode of the system (Drive/Bypass) from either the bypass control panel or digital input.**

f. **The bypass shall include the ability to know the phase sequence and provide a phase sequence fault to indicate if the bypass and drive would run the motor in the opposite direction, this feature shall be enabled by default**

g. **The bypass shall include a supervisory control mode that monitors the value of the drive's analog input (feedback). This feedback value is used to control the bypass contactor on/off state. The supervisory mode shall allow the user to maintain hysteresis control over applications.**

h. **Selectable Class 10, 20, or 30 electronic motor overload protection shall be included in both drive and bypass mode.**

i. **The drive and bypass shall be designed to operate as an integrated system when in Override mode. Whether operating in drive or bypass mode, the low priority safeties will be ignored, and high priority safeties will be followed. External start/stop commands will be ignored. There shall be four selectable Override modes:**

1) **Bypass only, with two smoke control modes:**

a) **Fixed pre-configuration of digital inputs**

b) **Configurable high/low priority safeties and faults, to allow configuration to meet needs of local Authority Having Jurisdiction**

2) **Drive only**

3) **Drive then transfer to bypass, in the event of a drive fault**

4) **Force to Stop**

j. **Before the bypass circuit can be tested in commissioning, the drive must start the motor to check for shorts and ground faults**

8. **Network communications – the bypass shall include BACnet MS/TP, Modbus, and Johnson Controls N2 as standard. The bypass BACnet implementation shall be BTL Listed to Revision 14 or later. Optional communication cards for BACnet/IP, LonWorks, Profibus, Profinet, Ethernet/IP, Modbus TCP, and DeviceNet shall be available.**

a. **The bypass relay output status, digital input status, warning and fault information can be monitored over the network. Status information shall be monitored, including; operating mode (drive vs bypass), current drawn in bypass mode, broken belt, and phase-to-phase voltage. The bypass start/stop command, force to bypass command, and relay outputs shall be capable of being controlled over the network.**

PART 3 EXECUTION ~~(NOT APPLICABLE)~~

3.01 EXAMINATION

A. Examine areas, surfaces and substrates to receive vfcs with installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the work.

B. Examine vfc before installation. Reject vfcs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before vfc installation.

D. Prepare written report, endorsed by installer, listing conditions detrimental to performance of the work

E. Proceed with installation only after unsatisfactory conditions have been corrected

3.02 INSTALLATION

A. Wall-mounting controllers: install with tops at uniform heigh and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers

not on walls, provide freestanding racks complying with section 260526 “hangers and supports for electrical systems.”

B. Roof-mounting controllers: install vfc on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
   1. Curbs and roof penetrations are specified in section 0707200 “roof accessories.”
   2. Structural-steel channels are specified in section 260529 “hangers and supports for electrical systems.”

C. Temporary lifting provisions: remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch vfc.

E. Install fuses in control circuits if not factory installed. Comply with requirements in section 262813 "fuses.”

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

3.03 CONTROL WIRING INSTALLATION

A. Install wiring between vfcs and remote devices and facility's central-control system. Comply with requirements in section 260523 "control-voltage electrical power cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.

D. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.04 IDENTIFICATION

A. Identify vfcs, components, and control wiring. Comply with requirements for identification specified in section 260553 "identification for electrical systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each vfc with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

B. Operating instructions: frame printed operating instructions for vfcs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of vfc units.

3.05 FIELD QUALITY CONTROL

A. Testing agency: owner will engage a qualified testing agency to perform tests and inspections.

B. Acceptance testing preparation:
   1. Test insulation resistance for each vfc element, bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and inspections:
   1. Inspect vfc, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each vfc element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at vfc locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify architect, construction manager, owner, and commissioning agent before starting the motor(s).
   5. Test each motor for proper phase rotation.
   6. Perform tests according to the inspection and test procedures for adjustable speed drives stated in neta acceptance testing specification. Certify compliance with test parameters.
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
   A. Initial infrared scanning: after substantial completion, but not more than 60 days after final acceptance, perform an infrared scan of each vfc. Remove front panels so joints and connections are accessible to portable scanner.
   B. Follow-up infrared scanning: perform an additional follow-up infrared scan of each vfc 11 months after date of substantial completion.
   C. Instruments and equipment: use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Vfcs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the vfc and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.06 STARTUP SERVICE

A. Perform startup service with the assistance of a manufacturer field serivice technician.

B. Complete installation and startup checks according to manufacturer's written instructions

3.07 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to substantial completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for nema premium efficient motors if required). Where these maximum settings do not allow starting of a motor, notify architect, construction manager, owner, and commissioning agent before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

3.08 PROTECTION

A. Replace vfcs whose interiors have been exposed to water or other liquids prior to substantial completion.

3.09 DEMONSTRATION

A. Train owner's maintenance personnel to adjust, operate, reprogram, and maintain vfcs

END OF SECTION 23 05 13

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.
   3. Grout.
   4. Silicone sealants.

B. Related Requirements:
   1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 SLEEVES

A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.

2.02 STACK-SLEEVE FITTINGS

A. Description: Manufactured, galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

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

2.04 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-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, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 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, ASTM C920, Type S, Grade NS, Class 25, use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

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

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, and concrete walls.
   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 above finished floor level.
   3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use 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."

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.03 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.

B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

3.04 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   2. Concrete Slabs Above Grade:
      a. Piping Smaller Than NPS 6: Steel pipe sleeves or Stack-sleeve fittings

3. Interior Partitions:
   b. Piping Smaller Than NPS 6: Steel pipe sleeves.

END OF SECTION 23 05 17

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SECTION 23 05 18
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 DEFINITIONS

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

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.02 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping :
      a. Insulated Piping: One-piece steel with polished, chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
      d. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
   2. Escutcheons for Existing Piping to Remain:
      a. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
      c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
      d. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet 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: Split floor plate.

2. Existing Piping to Remain: Split floor plate.

3.02 FIELD QUALITY CONTROL

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

END OF SECTION 23 05 18

SECTION 23 05 19
METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Duct-thermometer mounting brackets.
6. Thermowells.
7. Dial-type pressure gages.
8. Gage attachments.
9. Test plugs.
10. Test-plug kits.
11. Sight flow indicators.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 BIMETALLIC-ACTUATED THERMOMETERS

A. Standard: ASME B40.200.

B. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.

C. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.

D. Connector Type(s): Union joint, adjustable angle or, rigid, back and rigid, bottom, with unified-inch screw threads.

E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: Plain glass or plastic.

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.02 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:
1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel; 6-inch nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.

5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Pointer: Dark-colored metal.
7. Window: Glass or plastic.
8. Ring: Metal.
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device or rigid, back and rigid, bottom; with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
11. Accuracy: Plus or minus 1 percent of scale range.

2.03 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
1. Standard: ASME B40.200.
2. Case: Cast aluminum; 6-inch nominal size.
3. Case Form: Back angle or Straight unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue or red organic liquid.
5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
6. Window: Glass or plastic.
7. Stem: Aluminum or brass and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
8. Connector: 3/4 inch, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.04 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:
1. Case: Metal; 7-inch nominal size unless otherwise indicated.
2. Scale(s): Deg F and deg C.
3. Case Form: Adjustable angle.
4. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
5. Stem: Aluminum and of length to suit installation.
    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.
6. Display: Digital.
7. Accuracy: Plus or minus 2 deg F.

2.05 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.06 THERMOWELLS

A. Thermowells:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.

9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.07 DIAL-TYPE PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Standard: ASME B40.100.
2. Case: Liquid-filled, Sealed type(s); cast aluminum or drawn steel; 6-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal or Brass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.08 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of brass or steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball , with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.09 TEST PLUGS

A. Description: Test-station fitting made for insertion in piping tee fitting.

B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

C. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

D. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.10 TEST-PLUG KITS

A. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

B. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

C. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

D. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

E. Carrying Case: Metal or plastic, with formed instrument padding.

2.11 SIGHT FLOW INDICATORS

A. Description: Piping inline-installation device for visual verification of flow.

B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

C. Minimum Pressure Rating: 125 psig.

D. Minimum Temperature Rating: 200 deg F.

E. End Connections for NPS 2 and Smaller: Threaded.

F. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install valve and snubber in piping for each pressure gage for fluids (except steam).

I. Install valve and syphon fitting in piping for each pressure gage for steam.

J. Install test plugs in piping tees.

K. Install flow indicators in piping systems in accessible positions for easy viewing.

L. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings in accessible locations for attachment to portable indicators.

O. Install thermometers in the following locations:
   1. Inlet and outlet of each hydronic coil in air-handling units.
   2. Outside-, return-, supply-, and mixed-air ducts.

P. Install pressure gages in the following locations:
   1. Inlet and outlet of each hydronic coil in air-handling units

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

3.03 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic coil in air-handling units shall be one of the following:
   1. Liquid-filled, Sealed, bimetallic-actuated type.
   2. Direct-mounted, metal-case, vapor-actuated type.
   3. Compact-style, liquid-in-glass type.
   4. Direct-mounted, light-activated type.
   5. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

B. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
   1. Liquid-filled, Sealed, bimetallic-actuated type.
   2. Direct-mounted, metal-case, vapor-actuated type.
   3. Compact-style, liquid-in-glass type.
   4. Direct-mounted, light-activated type.

C. Thermometer stems shall be of length to match thermowell insertion length.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F and minus 20 to plus 50 deg C.

B. Scale Range for Air Ducts: 0 to 150 deg F and minus 20 to plus 70 deg C.

3.06 PRESSURE-GAGE SCHEDULE

A. Pressure gages at inlet and outlet of each hydronic coil in air-handling shall be one of the following:
   1. Liquid-filled, Sealed, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 psi and 0 to 600 kPa.

END OF SECTION 23 05 19

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SECTION 23 05 23.11
GLOBE VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Bronze globe valves.
   2. Iron globe valves.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle and globe valves closed to prevent rattling.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.1 for power piping valves.
   6. ASME B31.9 for building services piping valves.

C. Refer to HVAC valve schedule articles for applications of valves.

D. Valve Pressure and 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. Valves in Insulated Piping: With 2-inch stem extensions.

2.02 BRONZE GLOBE VALVES

A. Bronze Globe Valves, Class 125:
   1. Description:
      a. Standard: MSS SP-80, Type 1.
      b. CWP Rating: 200 psig.
      c. Body Material: ASTM B62, bronze with integral seat and screw-in bonnet.
      d. Ends: Threaded or solder joint.
      e. Stem and Disc: Bronze.

f. Packing: Asbestos free.
g. Handwheel: Malleable iron.

2.03 IRON GLOBE VALVES

A. Iron Globe Valves, Class 125:
1. Description:
a. Standard: MSS SP-85, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.
g. Operator: Handwheel.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 230553 "HVAC Identification" for valve tags and schedules.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Bronze angle or globe valves, Class 125, bronze disc, with soldered or threaded ends.

B. Pipe NPS 2-1/2 and Larger: Iron globe valves, Class 125, with flanged ends.

END OF SECTION 23 05 23.11

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SECTION 23 05 23.12
BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Brass ball valves.
   2. Bronze ball valves.
   3. Steel ball valves.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.05 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 weld 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

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.5 for flanges on steel valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder-joint connections.
   5. ASME B31.1 for power piping valves.
   6. ASME B31.9 for building services piping valves.

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

D. Refer to HVAC valve schedule articles for applications of valves.

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

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

G. Valve Actuator Types:
   1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
   2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
   1. Include 2-inch stem extensions.

2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

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

2.02 BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded or solder.
g. Seats: PTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

B. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded or solder.
g. Seats: PTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Regular.

C. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.03 BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port and Bronze or Brass Trim, Threaded Ends:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.

j. Port: Full.

B. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Regular.

C. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Regular.

D. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:
1. Description:
a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Three piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.04 STEEL BALL VALVES

A. Steel Ball Valves with Full Port and Stainless-Steel Trim, Class 150:
1. Description:
a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A216, Type WCB.
e. Ends: Flanged.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.04 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller: Brass or bronze ball valves, two or three piece, with brass or bronze trim, full or regular port, threaded or solder-joint ends.
   1. Valves may be provided with solder-joint ends instead of threaded ends.

B. Pipe NPS 2-1/2 and Larger:
   1. Steel ball valves, Class 150.

END OF SECTION 23 05 23.12

SECTION 23 05 23.14
CHECK VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Bronze swing check valves.
   2. Iron swing check valves.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
   1. ASME B1.20.1 for threads for threaded-end valves.
   2. ASME B16.1 for flanges on iron valves.
   3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   4. ASME B16.18 for solder joint.
   5. ASME B31.1 for power piping valves.
   6. ASME B31.9 for building services piping valves.

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

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

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

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

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

2.02 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:
   1. Description:
      a. Standard: MSS SP-80, Type 3.
      b. CWP Rating: 200 psig.
      c. Body Design: Horizontal flow.
      d. Body Material: ASTM B62, bronze.
      e. Ends: Threaded.
      f. Disc: Bronze.

2.03 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.
      c. Body Design: Clear or full waterway.
      d. Body Material: ASTM A126, gray iron with bolted bonnet.
      e. Ends: Flanged.
      f. Trim: Bronze.
      g. Gasket: Asbestos free.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

F. Swing Check Valves: In horizontal position with hinge pin level.

G. Install valve tags. Comply with requirements for valve tags and schedules in Section 230553 "HVAC Identification.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

B. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules.

3.05 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Bronze swing check valves with bronze disc, Class 125.

B. Pipe NPS 2-1/2 and Larger:
   1. NPS 2-1/2 to NPS 4: Iron valves may be provided with threaded ends instead of flanged ends.
   2. Iron swing check valves with metal seats, Class 125.

END OF SECTION 23 05 23.14

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SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Metal pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Equipment supports.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
   3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
   4. Section 233113 "Metal Ducts" for duct hangers and supports.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Equipment supports.

1.04 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.05 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

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

2.02 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 stainless steel.

B. Copper Pipe and Tube Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.03 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.

2.04 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted extruded-aluminum channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.

2.05 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi 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 beyond sheet metal shield for piping operating below ambient air temperature.

2.06 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. Indoor Applications: Zinc-coated or stainless steel.
2. Outdoor Applications: Stainless steel.

2.07 EQUIPMENT SUPPORTS

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

2.08 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

D. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

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, 28-day compressive strength.

PART 3 - EXECUTION

3.01 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.

3.02 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 the 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. 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.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. 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 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.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. 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.

M. 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 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 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: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 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.

3.04 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.

3.05 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.

3.06 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting", Section 099123 "Interior Painting", and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.07 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 finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper or stainless steel 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.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
   4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, 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.
   7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
   10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
   11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
   12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
   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, 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, 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 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 30750), from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

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.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 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 up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F 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 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.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
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.
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 or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

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SECTION 23 05 48
VIBRATION CONTROLS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Housed-spring isolators.
4. Restrained-spring isolators.
5. Housed-restrained-spring isolators.
6. Resilient pipe guides.
7. Elastomeric hangers.
8. Spring hangers.
9. Snubbers.
10. Restraints - rigid type.
11. Restraint accessories.
12. Post-installed concrete anchors.
13. Concrete inserts.
14. Vibration isolation equipment bases.

1.02 DEFINITIONS

A. IBC: International Building Code.

1.03 SUBMITTALS

A. Furnish shop drawings adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of equipment.

B. Include in the vibration isolation equipment submittal drawings the following information:
1. Isolation mounting deflections.
2. Spring diameters, compressed spring heights at rated load; solid spring heights, where steel spring isolation mountings are used.
3. Equipment operating speed.

C. Product Data: Manufacturer's printed data, test reports, catalog cuts and recommended method of installation.

1.04 QUALITY ASSURANCE

A. SMACNA, ASHRAE, NFPA

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS GENERAL

A. For the purpose of establishing design and quality, products are identified by several manufacturers' names and catalog numbers. The equivalent items of other manufacturers will be accepted, as approved by the A/E. Approved manufacturers are as follows:
1. Sound and Vibration Isolation:
a. Mason Industries, Inc. - M.I.I.
b. Vibration Eliminator Co. - V.E.C.
c. Vibration Mountings & Controls, Inc. - V.M.C.I.
d. Consolidated Kinetics Co. - C.K.C.
e. Korfund Dynamics Co. - K.D.C.
f. Amber Booth - A.B.
2. Mounting Sizes: Determined by the mounting manufacturer.
3. Mounting systems, including piping isolator components of the isolation mounting, shall not be resonant with the forcing frequencies of the supported equipment or supporting structure.

4. Where equipment is located outdoors, vibration isolation equipment shall be weatherproof as required for operation in an exposed environment.
5. See specification and schedules for deflection and mounting type number.

2.02 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
2. Size: Factory or field cut to match requirements of supported equipment.
3. Minimum deflection as indicated on Drawings.
4. Pad Material: Oil- and water-resistant rubber.

2.03 ELASTOMERIC ISOLATION MOUNTS

A. Elastomeric Isolation Mounts: EIM
1. Mounting Plates:
a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure, if required.
2. Minimum deflection as indicated on Drawings.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.04 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: HSI.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Minimum deflection as indicated on Drawings.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
7. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
8. Top housing with elastomeric pad.

2.05 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
2. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
3. Top plate with threaded mounting holes.
4. Internal leveling bolt that acts as blocking during installation.
5. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
6. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
7. Minimum Additional Travel: 50 percent of the required deflection at rated load.
8. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
9. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
10. Minimum deflection as indicated on Drawings.

2.06 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
   1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
      a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psi.
      b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Minimum deflection as indicated on Drawings.

2.07 RESILIENT PIPE GUIDES

A. Telescopic Arrangement of Two Steel Tubes or Post and Sleeve Arrangement Separated by a Minimum 1/2-inch-Thick Neoprene:
   1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.08 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Damping Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel-to-steel contact.
   3. Minimum deflection as indicated on Drawings.

2.09 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
   1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Minimum deflection as indicated on Drawings.
   6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
   8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
   9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.10 SNUBBERS

A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Post-Installed Concrete Anchor Bolts: Secure to concrete surface with post-installed concrete anchors. Anchors to be prequalified in accordance with ACI 355.2 testing and designated in accordance with ACI 318-14 Ch. 17.
   2. Preset Concrete Inserts: Prequalified in accordance with ICC-ES AC446 testing.
   3. Anchors in Masonry: Design in accordance with TMS 402.

4. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
5. Resilient Cushion: Maximum 1/4-inch air gap, and minimum 1/4 inch thick.

2.11 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe as per NFPA 13, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.12 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables .

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.13 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:
   1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:
   1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

2.14 CONCRETE INSERTS

A. Provide preset concrete inserts that are prequalified in accordance with ICC-ES AC466 testing.

B. Comply with ANSI/MSS SP-58.

2.15 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
   1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
   3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

PART 3 EXECUTION

3.01 ALL EQUIPMENT, PIPING, ETC. TO BE MOUNTED ON OR SUSPENDED FROM APPROVED FOUNDATIONS AND SUPPORTS, ALL AS SPECIFIED HEREIN, AS SHOWN ON THE DRAWINGS, OR AS REQUIRED BY LANDLORD.

3.02 GUARANTEE THE VIBRATION ISOLATION SYSTEMS TO HAVE THE REQUIRED DEFLECTION. MOUNTING SYSTEMS AND COMPONENTS OF THE ISOLATION MOUNTING NOT TO BE RESONANT WITH ANY OF THE FORCING FREQUENCIES OF THE SUPPORTED EQUIPMENT OR PIPING. MOUNTING SIZES TO BE DETERMINED BY THE MOUNTING MANUFACTURER, AND THE SIZES INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS.

3.03 THE INSTALLED VIBRATION ISOLATION SYSTEM FOR EACH FLOOR OR CEILING SUPPORTED EQUIPMENT TO HAVE A MAXIMUM LATERAL MOTION UNDER EQUIPMENT START-UP OF SHUTDOWN CONDITIONS OF 1/4". MOTIONS IN EXCESS TO BE RESTRAINED BY APPROVED SPRING TYPE MOUNTINGS.

3.04 PROVIDE MOUNTINGS INCORPORATING VERTICAL LIMIT STOPS WITH 1/4" SPACERS. THE MOUNTINGS TO SERVE AS BLOCKING DURING INSTALLATION. ADJUST MOUNTINGS AND REMOVE SPACERS AFTER EQUIPMENT OPERATING LOADS.

3.05 PROTECT ALL MOUNTING SYSTEMS EXPOSED TO WEATHER AND OTHER CORROSIVE ENVIRONMENTS WITH FACTORY CORROSION RESISTANCE. ALL METAL PARTS OF MOUNTING (EXCEPT SPRINGS AND HARDWARE) TO BE HOT DIP GALVANIZED. SPRINGS TO BE CADMIUM PLATED AND NEOPRENE COATED. NUTS AND BOLTS TO BE CADMIUM PLATED.

3.06 WHERE STEEL SPRING ISOLATION SYSTEMS ARE DESCRIBED ABOVE THE MOUNTING ASSEMBLIES TO UTILIZE BARE SPRINGS WITH THE SPRING DIAMETER NOT LESS THAN 0.8 OF THE LOADED OPERATING HEIGHT OF THE SPRING. EACH SPRING ISOLATOR TO BE DESIGNED AND INSTALLED SO THAT THE ENDS OF THE SPRING REMAIN PARALLEL DURING AND AFTER THE SPRING SPECIFIED MINIMUM DEFLECTION FROM LOADED OPERATING HEIGHT TO SPRING SOLID HEIGHT OF 50% OF THE RATED DEFLECTION.

3.07 PROVIDE, AS SHOWN OR AS APPROVED, ALL NECESSARY SUPPORTS FOR EQUIPMENT FURNISHED UNDER THIS SPECIFICATION. TO MEET THE VARYING CONDITIONS IN EACH CASE, THESE SUPPORTS TO CONSIST OF PIPESTANDS, STEEL ANGLE OR STRAP HANGERS, SADDLES, BRACKETS, ETC., AS SHOWN OR AS APPROVED. ALL SUCH SUPPORTS TO HAVE SUBSTANTIAL FLANGES, BOLTED TO FLOOR CONSTRUCTION; HANGERS TO BE SUPPORTED FROM FRAMING AS DESCRIBED HEREIN. SUPPORTS TO BE PROPERLY LOCATED WITH REFERENCE TO ANY SUPPORTING PADS, LEGS, ETC., OF THE EQUIPMENT CARRIED AND MUST BE OF SUCH NUMBER AND SO DISTRIBUTED AS NOT TO BRING ANY UNDUE STRAINS UPON THE EQUIPMENT. ALL DETAILS TO BE AS APPROVED.

3.08 PROVIDE SUITABLE BRACKETS, PIPESTANDS, PIERS OR OTHER SUPPORTS FOR ALL COILS, AIR FILTERS, MIXING AND CONTROL DAMPERS, ETC., SECURELY CLAMPED TO STEEL BEAMS, COLUMNS OR BEARING WALLS. ALL DETAILS OF THE WORK TO BE SHOWN ON THE DRAWINGS OR AS APPROVED.

3.09 GUARANTEE THAT THE WORK AS INSTALLED UNDER THIS SECTION OF THE SPECIFICATIONS WILL NOT RESULT IN THE TRANSMISSION OF OBJECTIONABLE NOISE OR VIBRATION TO ANY OCCUPIED PARTS OF THE BUILDING AND TAKE FULL RESPONSIBILITY FOR ANY NECESSARY MODIFICATIONS OF THIS EQUIPMENT, OR OF THE FOUNDATIONS AND SUPPORTS FOR THE SAME, NECESSARY TO SECURE THIS RESULT. ANY CORRECTIVE WORK REQUIRED TO ACCOMPLISH THE ABOVE WILL BE BORNE AT THE SOLE COST AND EXPENSE OF THIS CONTRACTOR.

3.10 NO CEILING COMPONENTS SHALL TOUCH ANY PIECE OF HVAC EQUIPMENT OR ASSOCIATED DUCTWORK, PIPING, ETC.

END OF SECTION 23 05 48

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Equipment labels.
   2. Warning size and labels
   3. Pipe labels.
   4. Duct labels.
   5. Stencils.
   6. Valve tags.

1.03 SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve-numbering scheme.

D. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch, anodized aluminum, 0.032-inch 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.
   4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, 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. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, with predrilled holes for attachment hardware.
   2. Letter and Background Color: As indicated for specific application under Part 3.
   3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
   4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   6. Fasteners: Stainless steel rivets or self-tapping screws.

7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.02 WARNING SIZE AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving having predrilled holes for attachment hardware.

B. Letter color: white.

C. Background color: red.

D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless steel rivets or self-taping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.03 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 cover full 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 main distribution piping. Arrows may be either integral with label or applied separately.
   3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.04 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 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.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, 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. Duct service

3. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.
4. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.05 STENCILS

A. Stencils Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Material: Aluminum
   2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.06 VALVE TAGS

A. Description: Stamped 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 19-gauge minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire 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 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.

PART 3 - EXECUTION

3.01 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.

3.02 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.

3.03 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 INSTALLATION OF PIPE LABELS

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units.
   3. Where flow pattern is not obvious, mark each pipe at branch.
   4. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   5. At access doors, manholes, and similar access points that permit view of concealed piping.
   6. Near major equipment items and other points of origination and termination.
   7. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

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. 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. of equipment items and other points of origination and termination.
   4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:
   1. Chilled-Water Piping: White letters on an ANSI Z535.1 safety-green background.
   2. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.

3.05 INSTALLATION OF DUCT LABELS

A. Install plastic-laminated duct labels showing service and flow direction with permanent adhesive on air ducts.
   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-, and mixed-air ducts: White letters on blue background.

3.06 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 the following subparagraphs. All tags shall be 2” square and all lettering shall be white.
   1. Valve-Tag color:
      a. Chilled Water: white lettering , green background
      b. Refrigerant: white lettering, blue background
   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. Valve Numbering:
      a. Arrange numbering of valves based on the flor level. For example, First Floor No. 100-199; Second Floor No. 200-299, Roof No. R001-R99
      b. In all cases ,the valve tag shall be installed and match the floor in chich it is located.

END OF SECTION 23 05 53

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Testing, Adjusting, and Balancing of Air Systems:
      a. Constant-volume air systems.
      b. Variable-air-volume systems.
   2. Testing, Adjusting, and Balancing of Hydronic Piping Systems:
      a. Variable-flow hydronic systems.
   3. Duct leakage tests verification.
   4. Pipe leakage tests verification.
   5. HVAC-control system verification.

1.03 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.

1.04 SUBMITTALS

A. Qualification Data: Within 45 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: 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.05 QUALITY ASSURANCE

A. TAB Meeting: Conduct a TAB meeting at project site on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of seven days' advance notice of scheduled meeting time and location. Attendees shall include HVAC contractor, Construction manager, Engineer of record, and Commissioning Agent.
   1. Minimum Agenda Items:
      a. The Contract Documents examination report.
      b. The TAB plan.

c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

B. Certify TAB field data reports and perform the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. IECC 2021 Compliance: Applicable requirements in IECC 2021

E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

F. Qualifications: All testing, adjusting and balancing shall be performed by an AABC or NEBB –certified professional.

1.06 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.07 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Test and Balance services will be provided by the owner.

B. 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.

C. 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.

D. Examine the approved submittals for HVAC systems and equipment.

E. Examine equipment performance data, including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainer baskets are installed and clean.

K. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

L. Examine system pumps to ensure absence of entrained air in the suction piping.

M. Examine operating safety interlocks and controls on HVAC equipment.

N. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 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. System:
      a. Permanent electrical-power wiring is complete.
      b. Automatic temperature-control systems are operational.
      c. Equipment and duct access doors are securely closed.
      d. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
      e. Windows and doors can be closed so indicated conditions for system operations can be met.
   2. 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. Suitable access to balancing devices and equipment is provided.
   3. Hydronics:
      a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
      b. Piping is complete with terminals installed.
      c. Water treatment is complete.
      d. Systems are flushed, filled, and air purged.
      e. Strainers are pulled and cleaned.
      f. Control valves are functioning in accordance with the sequence of operation.
      g. Shutoff and balance valves have been verified to be 100 percent open.
      h. Pumps are started and proper rotation is verified.
      i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
      j. Variable-frequency controllers' startup is complete and safeties are verified.
      k. Suitable access to balancing devices and equipment is provided.

3.03 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, patch probe holes in ducts with same material and thickness as used to construct ducts.
   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.

E. Mechanical contractor is to provide all services necessary to support the test and balance contractor, including the addition of required test and balance devices and correction of all mechanical deficiencies.

F. All equipment startups are to be coordinated with the Commissioning Agent. The Commissioning Agent must be given 48 hours notice prior to startup.

G. All hydronic pipe and duct testing shall be conducted per Tulane's Specifications and is to be witnessed by the Commissioning Agent. All piping and ductwork is to be pre-tested by the contractor prior to scheduling the Commissioning Agent. Commissioning Agent must be given 48 hours notice prior to testing.

3.04 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. Air-handling units.
   5. Fan coil units.

3.05 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. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.06 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 Engineer 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.

3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:
1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:
a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
d. Adjust controls so that terminal is calling for minimum airflow.
e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.

f. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
   a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
   b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow, so that connected total matches fan selection and simulates actual load in the building.
   c. 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.
   d. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
6. 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 any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
   a. Balance the return-air ducts and inlets.
   b. Verify that terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit, and adjust the system static pressure set point to 0 minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
   a. Re-measure and confirm that total airflow is within design.
   b. Re-measure final fan operating data, speed, volts, amps, and static profile.
   c. Mark final settings.
   d. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
   e. Verify tracking between supply and return fans.

3.08 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:
   1. Check expansion tank for proper setting.
   2. Check highest vent for adequate pressure.
   3. Check flow-control valves for proper position.
   4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
   5. Verify that motor controllers are equipped with properly sized thermal protection.
   6. 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.
   1. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:
   1. Verify that the pressure-differential sensor(s) is located as indicated.
   2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:
   1. Adjust pumps to deliver total design flow.
      a. Measure total water flow.
         1) Position valves for full flow through coils.
         2) Measure flow by main flow meter, if installed.
         3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
      b. Measure pump TDH as follows:
         1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
         2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
         3) Convert pressure to head and correct for differences in gauge heights.
         4) 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.
         5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
      c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
   2. Adjust flow-measuring devices installed in mains and branches to design water flows.
      a. Measure flow in main and branch pipes.
      b. Adjust main and branch balance valves for design flow.
      c. Re-measure each main and branch after all have been adjusted.
   3. Adjust flow-measuring devices installed at terminals for each space to design water flows.
      a. Measure flow at terminals.
      b. Adjust each terminal to design flow.
      c. Re-measure each terminal after it is adjusted.
      d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
      e. Perform temperature tests after flows have been balanced.
   4. For systems with pressure-independent valves at terminals:
      a. Measure differential pressure and verify that it is within manufacturer's specified range.
      b. Perform temperature tests after flows have been verified.
   5. For systems without pressure-independent valves or flow-measuring devices at terminals:
      a. Measure and balance coils by either coil pressure drop or temperature method.
      b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
   6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
   7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
   8. Mark final settings and verify that all memory stops have been set.
   9. 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.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.
   a. Measure total water flow.
      1) Position valves for full flow through coils.
      2) Measure flow by main flow meter, if installed.
      3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
   b. Measure pump TDH as follows:
      1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      3) Convert pressure to head and correct for differences in gauge heights.
      4) 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.
      5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
   c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
4. Adjust flow-measuring devices installed in mains and branches to design water flows.
   a. Measure flow in main and branch pipes.
   b. Adjust main and branch balance valves for design flow.
   c. Re-measure each main and branch after all have been adjusted.
5. Adjust flow-measuring devices installed at terminals for each space to design water flows.
   a. Measure flow at terminals.
   b. Adjust each terminal to design flow.
   c. Re-measure each terminal after it is adjusted.
   d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
   e. Perform temperature tests after flows have been balanced.
6. For systems with pressure-independent valves at terminals:
   a. Measure differential pressure, and verify that it is within manufacturer's specified range.
   b. Perform temperature tests after flows have been verified.
7. For systems without pressure-independent valves or flow-measuring devices at terminals:
   a. Measure and balance coils by either coil pressure drop or temperature method.
   b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.
8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:
    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
    c. Mark final settings.
13. Mechanical pipe testing requirements:
    a. CHW: Hydrostatic at 200 psi for 4 hours
    b. Hot water: Hydrostatic at 150 psi for 4 hours.

3.10 PROCEDURES FOR MOTORS

A. Motors ½ HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Low pressure ductwork shall be tested 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.

C. Verify that proper test methods are used and that leakage rates are within specified limits.

D. Report deficiencies observed.

3.12 PIPE LEAKAGE TESTS

A. Verify that proper test methods are used and that leakage rates are within specified limits.

B. Report deficiencies observed.

3.13 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.

3.14 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 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus 10 percent or minus 5 percent. If design value is less than 100 cfm, within 10 cfm.
3. Chilled-Water Flow Rate: Plus or minus 10 percent. If design value is less than 10 gpm, within 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.15 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.

3.16 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. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB 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. Face and bypass damper settings at coils.
      f. Fan drive settings, including settings and percentage of maximum pitch diameter.
      g. Variable-frequency controller settings for variable-air-volume systems.
      h. Settings for pressure controller(s).
      i. Other system operating conditions that affect performance.
   16. 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 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. Sheave make, size in inches, and bore.
      i. Center-to-center dimensions of sheave and amount of adjustments in inches.
      j. Number, make, and size of belts.
      k. Number, type, and size of filters.
   2. Motor Data:
      a. Motor make, and frame type and size.
      b. Horsepower and speed.
      c. Volts, phase, and hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Center-to-center dimensions of sheave and amount of adjustments in inches.
   3. Test Data (Indicated and Actual Values):
      a. Total airflow rate in cfm.
      b. Total system static pressure in inches wg.
      c. Fan speed.
      d. Inlet and discharge static pressure in inches wg.
      e. For each filter bank, filter static-pressure differential in inches wg.
      f. Preheat-coil static-pressure differential in inches wg.
      g. Cooling-coil static-pressure differential in inches wg.
      h. Heating-coil static-pressure differential in inches wg.
      i. List for each internal component with pressure-drop, static-pressure differential in inches wg.
      j. Outdoor airflow in cfm.
      k. Return airflow in cfm.
      l. Outdoor-air damper position.
      m. Return-air damper position.

F. Apparatus-Coil Test Reports:
   1. Coil Data:
      a. System identification.
      b. Location.
      c. Coil type.
      d. Number of rows.
      e. Fin spacing in fins per inch o.c.
      f. Make and model number.
      g. Face area in sq. ft..
      h. Tube size in NPS.
      i. Tube and fin materials.
      j. Circuiting arrangement.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Average face velocity in fpm.
      c. Air pressure drop in inches wg.

d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

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, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.
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, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

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.
      d. Duct static pressure in inches wg.
      e. Duct size in inches.
      f. Duct area in sq. ft..
      g. Indicated airflow rate in cfm.
      h. Indicated velocity in fpm.
      i. Actual airflow rate in cfm.
      j. Actual average velocity in fpm.
      k. Barometric pressure in psig.

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..
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Air velocity in fpm.
      c. Preliminary airflow rate as needed in cfm.
      d. Preliminary velocity as needed in fpm.
      e. Final airflow rate in cfm.
      f. Final velocity in fpm.
      g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data:
      a. System and air-handling-unit identification.
      b. Location and zone.
      c. Room or riser served.
      d. Coil make and size.
      e. Flowmeter type.
   2. Test Data (Indicated and Actual Values):
      a. Airflow rate in cfm.
      b. Entering-water temperature in deg F.
      c. Leaving-water temperature in deg F.
      d. Water pressure drop in feet of head or psig.
      e. Entering-air temperature in deg F.
      f. Leaving-air temperature in deg F.

L. Instrument Calibration Reports:
   1. Report Data:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.

e. Dates of calibration.

3.17 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 others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.18 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 23 05 93

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed and exposed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed and exposed return.
   4. Indoor Type I, commercial, kitchen hood exhaust.

B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."
   2. Section 233113 "Ductwork" for duct liners.

1.03 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.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 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.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.04 MASTICS AND COATINGS

A. Materials shall be 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 C755, Section 7.2.2, Table 2, for insulation type and service conditions.
   2. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
   3. Color: White.

C. Vapor-Retarder Mastic: Solvent based; 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: 0 to 180 deg F.
   3. Color: White.

D. Breather Mastic: Water based; suitable for indoor use on above ambient services.
   1. Water-Vapor Permeance: ASTM E96, greater than 1.0 perm at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   3. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.06 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: Aluminum.

B. ASJ Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
   4. Color: White.

2.07 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.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. in. for covering ducts.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for ducts.

2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch 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.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-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, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch 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 thick by 2 inches square.
b. Spindle: Stainless steel, fully annealed, 0.106-inch- 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 thick by 1-1/2 inches in diameter.
b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
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 thick by 2 inches square.
b. Spindle: Stainless steel, fully annealed, 0.106-inch-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-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.13 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A167 or ASTM A240/A240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.01 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.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. 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.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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.
   1. Comply with requirements in Section 078413 "Penetration Firestopping."

C. 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.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches 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 from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
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-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.06 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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-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 laps at longitudinal seams and 3-inch-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 metal jackets are indicated, install with 2-inch 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 o.c. and at end joints.

3.07 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.08 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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed and exposed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed and exposed return.
   4. Indoor, Type I, commercial, kitchen hood exhaust.

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.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Minimum insulation shall be R-8, installed. Insulation shall be in compliance with IECC 2021.

B. Insulation thickness and density listed in this article are minimum values. Higher values may be required to meet Code required R-value.

C. Concealed and exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

D. Concealed and exposed, round and flat-oval, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

E. Concealed and exposed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

F. Concealed and exposed, rectangular, supply-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

G. Concealed and exposed, rectangular, return-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

H. Concealed and exposed, rectangular, outdoor-air duct insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

I. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.

J. Concealed and exposed, supply-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

K. Concealed and exposed, return-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

L. Concealed and exposed, outdoor-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.
   2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

3.12 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. Ducts and Plenums, Exposed:
   1. Aluminum, Smooth: 0.020 inch thick.
   2. Painted Aluminum, Smooth: 0.020 inch thick.

END OF SECTION 23 07 13

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SECTION 23 0 719
HVAC PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulation for HVAC piping systems.

B. Related Requirements:
   1. Section 230713 "Duct Insulation" for duct insulation.

1.03 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.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
   1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
   2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products shall be in compliance with IECC 2021 with Louisiana amendments.

D. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
   1. Preformed Pipe Insulation without Jacket: Type II, Class 1, without jacket.
   2. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ jacket.
   3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
   4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

I. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
   1. Preformed Pipe Insulation: Type I, Grade A, without factory-applied jacket or with factory-applied ASJ.
   2. 850 deg F.
   3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
   4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

D. Flexible Elastomeric Adhesive: Solvent-based adhesive.
   1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
   2. Wet Flash Point: Below 0 deg F.
   3. Service Temperature Range: 40 to 200 deg F.
   4. Color: Black.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

F. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS AND COATINGS

A. Materials shall be 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: 0 to plus 180 deg F.
   3. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
   1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
   2. Service Temperature Range: 0 to 180 deg F.
   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 at manufacturer's recommended dry film thickness.
   2. Service Temperature Range: 0 to plus 180 deg F.
   3. Color: White.

2.05 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   2. Service Temperature Range: 20 to plus 180 deg F.
   3. Color: White.

2.06 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
   1. Permanently flexible, elastomeric sealant.
      a. Service Temperature Range: Minus 150 to plus 250 deg F.
      b. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: Aluminum.

D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
   1. Fire- and water-resistant, flexible, elastomeric sealant.
   2. Service Temperature Range: Minus 40 to plus 250 deg F.
   3. Color: White.

2.07 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.

2.08 FIELD-APPLIED REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall 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: Color-code jackets based on system. Color as selected by Architect.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
   1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
      a. Factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
   2. Stainless Steel Jacket: ASTM A240/A240M.
      a. Factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) Tee covers.
         4) Flange and union covers.
         5) End caps.
         6) Beveled collars.
         7) Valve covers.
         8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

F. Self-Adhesive Outdoor Jacket: 60-mil-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 white aluminum-foil facing.

G. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.

H. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 25 and a smoke-developed index of 50 when tested in accordance with ASTM E84.

I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch 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.
   2. Thickness: 6.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch 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.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Width: 2 inches.
   2. Thickness: 3.7 mils.
   3. Adhesion: 100 ounces force/inch in width.
   4. Elongation: 5 percent.
   5. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches.
   2. Film Thickness: 2 mils.
   3. Adhesive Thickness: 1.5 mils.
   4. Elongation at Break: 120 percent.
   5. Tensile Strength: 20 psi in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
   1. Width: 3 inches.
   2. Film Thickness: 6 mils.
   3. Adhesive Thickness: 1.5 mils.
   4. Elongation at Break: 145 percent.
   5. Tensile Strength: 55 psi in width.

2.12 SECUREMENTS

A. Bands:
   1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
   2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.01 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.

3.02 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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the 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.

3.03 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, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

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.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches 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 more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches 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.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. 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.

D. 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."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, 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 or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as 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 or sectional pipe 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 using preformed fitting insulation or sectional pipe 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. 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 to fit. 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 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 shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as 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 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.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.07 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 mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.09 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 overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- 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 laps at longitudinal seams and 3-inch-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 and for horizontal applications, install with 1-inch 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 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 o.c. and at end joints.

3.10 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.

3.11 FIELD QUALITY CONTROL

E. Perform tests and inspections.

F. 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 shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

G. All insulation applications will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. 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.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Underground piping.
   2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. All piping insulation shall meet IECC 2021 performance requirements. Sizes listed are minimum size requirements.

B. Condensate and Equipment Drain Water:
   1. All pipe sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Chilled Water, 40 Deg F and below:
1. All pipe sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Chilled Water, Above 40 Deg F:
1. All pipe sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

F. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 2 inches thick.

G. Refrigerant Liquid Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches thick.
b. Flexible Elastomeric: 1 inch thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch 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. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.020 inch thick.
3. Painted Aluminum, Smooth: 0.020 inch thick.

D. Piping, Exposed:
1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.020 inch thick.
3. Painted Aluminum, Smooth: 0.020 inch thick.

END OF SECTION 23 07 19

SECTION 23 09 23.11
CONTROL VALVES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes control valves and actuators for DDC systems.

1.03 DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   3. Product description with complete technical data, performance curves, and product specification sheets.
   4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of product 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. Include diagrams for pneumatic signal and main air tubing.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control valve actuators served from a backup power source.

E. Environmental Conditions:

1. Provide electric control valve actuators, with protective enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Electric control valve actuators not available with integral enclosures, complying with requirements indicated, shall be housed in protective secondary enclosures.

F. Determine control valve sizes and flow coefficients by ISA 75.01.01.

G. Control valve characteristics and rangeability shall comply with ISA 75.11.01.
1. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
2. Valve pattern, three-way or straight through, shall be as indicated on Drawings.
3. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.
4. Modulating three-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
5. Fail positions unless otherwise indicated:
   a. Chilled Water: Close
6. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
7. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
8. Selection shall consider viscosity, flashing, and cavitation corrections.
9. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
10. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
11. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.
12. Control valve, pneumatic-control signal shall not exceed 200 feet. For longer distances, provide an electric/electronic control signal to the valve and an electric solenoid valve or electro-pneumatic transducer at the valve to convert the control signal to pneumatic.

2.02 BALL-STYLE CONTROL VALVES

A. Ball Valves with Two Ports and Characterized Disk:
1. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
3. Close-off Pressure: 200 psig.
4. Process Temperature Range: Zero to 212 deg F.
5. Body and Tail Piece: Cast bronze ASTM B61, ASTM B62, ASTM B584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:
   a. Material to match ball.
   b. Blowout-proof design.
   c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.
9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristics for A-Port: Equal percentage.
12. Flow Characteristics for B-Port: Modified for constant common port flow.

B. Ball Valves with Segmented Ball, Three-Way Pattern:
   1. Arrangement: Two single-port valves mated to a fabricated tee with interconnecting mechanical linkage.
   2. Performance:
      a. Process Temperature Rating: Minus 20 to plus 450 deg F.
      b. ASME B16.34, Class 150.
      c. Leakage: FCI 70-2, Class IV.
      d. Rangeability: 300 to 1.
      e. Rotation: Zero to 90 degrees.
      f. Equal percentage flow characteristic.
   3. Face-to-Face Dimensions: ASME B16.10.
   4. Valves NPS 3 through NPS 6: Flanged ends suitable for mating to ASME B16.5 flanges.
   5. Body: Carbon or stainless steel.
   6. Ball and Shaft: Stainless steel.
   7. Shaft and Segmented Ball: Pinned and welded.
   8. Ball Seat: Graphite.
   9. Packing: PTFE V-rings and graphite packing follower.
   10. Replaceable seat, ball, and shaft packing.
   11. Label each valve with following:
      a. Manufacturer's name, model number, and serial number.
      b. Body size.
      c. Flow directional arrow.

2.03 GLOBE-STYLE CONTROL VALVES

A. General Globe-Style Valve Requirements:
   1. Globe-style control valve body dimensions shall comply with ISA 75.08.01.
   2. Construct the valves to be serviceable from the top.
   3. For cage guided valves, trim shall be field interchangeable for different valve flow characteristics, such as equal percentage, linear, and quick opening.
   4. Reduced trim for one nominal size smaller shall be available for industrial valves NPS 1 and larger.
   5. Replaceable seats and plugs.
   6. Furnish each control valve with a corrosion-resistant nameplate indicating the following:
      a. Manufacturer's name, model number, and serial number.
      b. Body and trim size.
      c. Arrow indicating direction of flow.

B. Three-Way Globe Valves NPS 2 and Smaller:
   1. Globe Style: Mix flow pattern.
   2. Body: Cast bronze or forged brass with ASME B16.5, Class 250 rating.
   3. End Connections: Threaded.
   4. Bonnet: Screwed.
   5. Packing: PTFE V-ring.
   6. Plug: Top guided.
   7. Plug, Seat, and Stem: Brass or stainless steel.
   8. Process Temperature Range: 35 to 248 deg F.
   9. Ambient Operating Temperature: 35 to 150 deg F.
   10. Leakage: FCI 70-2, Class IV.
   11. Rangeability: 25 to 1.
   12. Linear flow characteristic.

C. Three-Way Globe Valves NPS 2-1/2 to NPS 6:
   1. Globe Style: Mix flow pattern.
   2. Body: Cast iron complying with ASME B61.1, Class 125.

3. End Connections: Flanged suitable for mating to ASME B16.5, Class 150 flanges.
4. Bonnet: Bolted.
5. Packing: PTFE cone-ring.
6. Plug: Top or bottom guided.
7. Plug, Seat, and Stem: Brass or stainless steel.
8. Process Temperature Rating: 35 to 281 deg F.
9. Leakage: 0.1 percent of maximum flow.
10. Rangeability: Varies with valve size between 6 and 10 to 1.
11. Modified linear flow characteristic.

2.04 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Actuators for Steam Control Valves: Shutoff against 1.5 times design pressure.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:
   1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
   2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dust-proof cast-iron, cast-steel or cast-aluminum housing.
   3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:
   1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without re-placement.
   2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Position Feedback:
   1. Where indicated, equip two-position actuators with limits switches or other positive means of a po-sition indication signal for remote monitoring of open and close position.
   2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

L. Fail-Safe:
   1. Where indicated, provide actuator to fail to an end position.
   2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
   3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

M. Integral Overload Protection:
   1. Provide against overload throughout the entire operating range in both directions.
   2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

N. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

O. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

P. Enclosure:
1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

Q. Stroke Time:
1. Operate valve from fully closed to fully open within 60 seconds.
2. Operate valve from fully open to fully closed within 60 seconds.
3. Move valve to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.

R. Sound:
1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONTROL VALVE APPLICATIONS

A. Control Valves:
1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
2. Chilled Water System, Three Way, Controlled by Temperature: Ball valves with two ports and characterized disk, Ball valves with segmented ball, three-way pattern, or Globe-style, three-way valves.

3.03 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.04 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Electrical Specifications.

C. Furnish and install power wiring. Comply with requirements in Electrical Specifications.

D. Furnish and install raceways. Comply with requirements in Electrical Specifications.

3.05 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2.

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 1.

F. Valve Orientation:
   1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
   2. Install valves in a position to allow full stem movement.
   3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. Clearance:
   1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
   2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

H. Threaded Valves:
   1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
   2. Align threads at point of assembly.
   3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
   4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

I. Flanged Valves:
   1. Align flange surfaces parallel.

2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.06 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Electrical Specifications.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with valve identification on valve and on face of ceiling directly below valves concealed above ceilings.

3.08 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.09 CHECKOUT PROCEDURES

A. Control Valve Checkout:
1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 23.11

SECTION 23 09 23.14
FLOW INSTRUMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Airflow measurement stations and sensors.
   2. Airflow transmitters.
   3. Liquid flow meters.
   4. Liquid flow sensors (primary elements).
   5. Liquid flow switches.
   6. Liquid flow transmitters.

B. Related Requirements:
   1. Section 230923 "HVAC Controls" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
   2. Section 230993.11 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.14.

1.03 DEFINITIONS

A. Ethernet: Local area network based on IEEE 802.3 standards.

B. FEP: Fluorinated ethylene propylene.

C. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.

D. PEEK: Polyetheretherketone.

E. PTFE: Polytetrafluoroethylene.

F. PPS: Polyphenylene sulfide.

G. RS-485: A TIA standard for multipoint communications using two twisted pairs.

H. RTD: Resistance temperature detector.

I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
   3. Product description with complete technical data, performance curves, and product specification sheets.
   4. Installation instructions, including factors affecting performance.
   5. Product certificates.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting details.

2. Include details of product 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. Include diagrams for air and process signal tubing.
5. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

B. Liquid sensors, meters, and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below Project minimum flow to signal abnormal flow conditions and to provide flexibility for changes in operation.

C. Source Limitations: For flow instruments, obtain products from single source from single manufacturer.

2.03 AIRFLOW MEASUREMENT STATIONS AND SENSORS

A. Performance Requirements:
   1. Adjustable for changes in system operational parameters.
   2. Airflow Sensor and Transmitter Range: Extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions.
   3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
      a. Product certificates are required.

B. Thermal Airflow Measurement Stations:
   1. Common Performance Requirements:
      a. Provide stations that are adjustable for changes in system operational parameters.
      b. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
      c. Thermal airflow stations with one or more sensor nodes mounted in a probe, and a remotely mounted microprocessor-based transmitter at each measurement location.
      d. Sensor Nodes: One self-heated and one zero-power bead-in-glass thermistor, using the principle of thermal dispersion.
      e. Airflow Rate and Temperature of Each Sensor: Equally weighted and averaged by the transmitter prior to output.
      f. Sensor-Node and Probe Assemblies:
         1) Sensor-Node Construction: Two bead-in-glass, hermetically sealed thermistors potted in a marine-grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Construct with only the thermistor located within the sensing node and all other electronic components outside the airstream. Epoxy- or glass-encapsulated chip thermistors or devices with exposed leads are not allowed. Devices that use epoxy- or glass-encapsulated chip thermistors, or electronics in the airstream, are unacceptable. Devices with exposed leads are unacceptable.

2) Store sensor-node airflow and temperature calibration data in a serial memory chip, in the cable connecting plug. Stored data does not require matching or adjustments to the transmitter in the field.
3) Sensing-Node Temperature Accuracy: Within 0.15 deg F over an operating range of minus 20 to plus 160 deg F and humidity range of 0 to 100 percent RH.
4) Sensor-Probe Mounting Bracket Construction: Type 304 stainless steel.
5) Internal Probe Wiring: Kynar-coated copper between the connecting cable and sensor nodes. PVC-jacketed wiring is unacceptable.
6) Internal Probe Wiring Connections: Solder joints and spot welds, sealed and protected from the elements, so that direct exposure to water will not affect instrument operation. Connectors within the probe, of any type, are unacceptable. Printed circuit boards within the probe are unacceptable.
7) Sensor-Probe Jacket: Integral, FEP jacket, plenum-rated CMP/CL2P, UL/cUL-listed cable, rated for exposures from minus 67 to plus 392 deg F, and for continuous and direct UV exposure. Plenum-rated PVC jacket cables are unacceptable.
8) Sensor-Probe Cable Connector Plug: Gold-plated pins for connection to the transmitter.

g. Transmitter Features and Functions:
1) High and/or low airflow alarm with user-defined set point and percent of set-point tolerance.
2) Manual or automatic alarm reset, and low-limit cutoff value may be selected to disable the alarm.
3) Alarm delay function, field defined.
4) Sensor-node malfunction via the system status alarm and ignore the sensor node that is in a fault condition.
5) Field configuration, diagnostics, and field output adjustment wizard that allow for a one- or two-point field adjustment to factory calibration for installations that require adjustment.
6) Automatic reset after power disruption, transients, and brown-outs through a watchdog timer circuit.
7) Operating temperature range of minus 20 to plus 120 deg F and humidity range of 5 to 95 percent RH.
8) Electrical Power Requirement: 24 V ac (between 22.8 and 26.4 V ac under load) at 20 VA maximum, using a switching power supply that is overcurrent and overvoltage protected.
9) Printed Circuit Board Interconnects: Gold-plated edge fingers, receptacle plug pins, and printed circuit board test points.
10) Printed Circuit Boards: Electroless nickel immersion gold (ENIG) plated.
11) Integrated Circuitry: Temperature-rated, industrial-grade. Commercial-grade integrated circuitry is not acceptable.
12) Integration Buffers: Separate integration buffers for display of airflow output, airflow signal output (analog and network), and individual sensor output (IR-interface).

2. For Air-Ducted/Plenum:
a. Airflow Station Performance:
1) Independent processing of up to 16 separately wired sensor-node assemblies.
2) Accuracy: Within 3 percent of reading for ducted applications, and within 5 percent of reading for non-ducted applications, when installed in accordance with manufacturer's recommended placement guidelines. Include the combined uncertainty of the sensor nodes and transmitter. For devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter, demonstrate compliance with the accuracy requirement over the entire operating range.

b. Sensor-Node and Probe Assemblies:
3) Performance rated and tested with a 100 percent survival rate in a 30-day saltwater and acid vapor test with written independent laboratory results.
4) Sensor-Node Calibration: Individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard.

a) Accuracy: Within 2 percent of reading over the entire calibrated airflow range of 0 to 5000 fpm.
b) Individually calibrate thermistor at a minimum of three temperatures to NIST-traceable temperature standards.

5) Provide the number of independent sensor nodes as follows:
a) For Duct/Plenum Area up to 0.5 sq. ft.: One.
b) For Duct/Plenum Area Greater Than 0.5 through 1.0 sq. ft.: Two.
c) For Duct/Plenum Area Greater Than 2.0 through 4.0 sq. ft.: Six.
d) For Duct/Plenum Area Greater Than 4.0 through 8.0 sq. ft.: Eight.

6) For an aspect ratio of 1.5 or less, and an area of 25 sq. ft. or greater, four probes are required.

7) Sensor-Probe Construction: Type 316 stainless steel tube, with each sensor probe containing one or more independently wired sensing nodes.

c. Transmitter:

1) Transmitter determines the average airflow rate and temperature of connected sensor nodes in an array for a single location.

2) User Interface: 16-character, alpha-numeric, LCD display, with two field-selectable analog output signals and network output capability. Provide one of the following transmitter configurations:

a) Model GTC116 Transmitter: Two field-selectable 0-to 10-V dc, or 4- to 20-mA, scalable, isolated, overcurrent protected analog output signals. The first output (AO1) provides the total airflow rate. The second output (AO2) is field configurable for temperature or low and/or high airflow set-point (user-defined) or system status alarm. The RS-485 (BACnet MS/TP, or Modbus RTU) network connection provides the average airflow rate, temperature, high and/or low airflow set-point alarm, system status alarm, individual sensor-node airflow rates, and individual sensor-node temperatures. The transmitter shall be provided with a Bluetooth low-energy interface card capable of transmitting all transmitter setup parameters, diagnostics, average airflow, and temperature of the device and the airflow and temperature of each sensor node. Software capable of capturing and displaying this transmission will be available via download to Android or iOS phone or tablet. Software shall allow for setup parameters, airflow, temperature, and diagnostic data to be saved on the phone or be emailed.

b) Model GTD116 Transmitter with Data-Logger Interface: Capable of logging airflow and temperature rates over specified time intervals.

C. Pitot-Tube Airflow Sensor Station:

1. Description: Multiple total- and static-pressure sensors positioned at the center of equal area of the station cross section and interconnected by respective averaging manifolds.
   a. Stations 4 sq. ft. and Smaller: One total-pressure sensor and one static-pressure sensor for every 16 sq. in. of station area.
   b. Stations Larger than 4 sq. ft.: One total-pressure sensor and one static-pressure sensor for every 36 sq. in. of station area.
2. Casing: Galvanized sheet steel at least 0.079 inch thick with coating complying with ASTM A653/A653M, G90. Casings shall be stainless steel, 0.0781 inch thick, when connected to stainless duct and aluminum, 0.063 inch thick, when connected to aluminum duct.
   a. Joints and Seams: Continuously weld. Clean galvanized areas damaged by welding and coat with aluminum paint.
   b. Casing Depth: At least 8 inches.
   c. Casing Flanges: Outward flange, minimum flange face 1.5 inches.
   d. Casing Configuration and Size: Match shape (rectangular, round, flat oval) and same size as adjacent duct unless otherwise indicated.
3. Include an open parallel cell air straightener or air equalizer honeycomb mechanically fastened to casing.
   a. Construct straightener or equalizer from Type 3003 aluminum or Type 316 stainless steel, depending on casing material. Use stainless steel for units with stainless steel casings.

4. Construct pressure sensor array from drawn copper or stainless steel tubing. Use stainless steel for units with stainless steel casings. Copper tubing shall comply with ASTM B75 and ASTM B280. Minimum tube wall thickness shall be 0.030 inch. Include internal piping and external pressure transmitter ports.
5. Station Labeling: Identification label on each station casing indicating model number, size, area, and application-specific airflow range.
6. Performance:
   a. Pressure Loss: 0.015-inch wg at 1000 fpm, or 0.085-inch wg at 2000 fpm.
   b. Accuracy: Within 2 percent of actual airflow.
   c. Self-Generated Sound: NC 40 and sound level within the duct shall not be amplified.
   d. Performance rated and tested according to AMCA 610. Each station shall bear the AMCA seal.

D. Pitot-Tube Fan Inlet Airflow Traverse Sensor:
1. Traverse manifold designed for mounting in fan inlets.
2. Contain multiple total- and static-pressure sensors placed at concentric area centers along the exterior surface of cylindrical manifold and internally connected to their respective averaging manifolds. Sensors shall not protrude beyond the surface of the manifold nor be adversely affected by particle contamination present in airstream.
3. Manifold (two per inlet) shall have dual end support swivel brackets suitable for mounting in the fan inlet bell and symmetrical averaging signal takeoffs and fittings.
4. Sensors shall be capable of producing steady, non-pulsating signals of standard total- and static-pressure without need for flow corrections or factors, with an accuracy of 3 percent of actual flow over a turndown range of 6 to 1.
5. Manifold Materials: Copper or anodized aluminum or Type 316 stainless steel.
6. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter copper and aluminum manifolds shall be the following:
   a. For Fan Inlets Smaller Than 20 Inches: 0.375 inch.
   b. For Fan Inlets 20 Inches and Larger: 0.75 inch.
7. Unless otherwise required by application and without affecting the fan and sensor performance, nominal diameter stainless steel manifolds shall be the following:
   a. For Fan Inlets Smaller Than 20 Inches: 0.375 inch.
   b. For Fan Inlets 20 through 48 Inches: 0.75 inch.

E. Piezometer Ring Fan Inlet Airflow Sensor:
1. In lieu of externally mounted fan inlet airflow sensors, option to provide fans with airflow measurement integral to fan inlet cones for continuous measurement of air volume flow rate.
2. Multiple pressure sensor points strategically placed along the circumference of the inlet cone and internally connected to an averaging ring manifold located behind the inlet cone.
3. Sensor points shall not protrude beyond the surface of the inlet cone nor be adversely affected by particle contamination present in the airstream.
4. Sensor shall produce steady, non-pulsating signals to achieve accuracy within 5 percent of actual airflow.
5. Sensor shall be non-intrusive and not impact fan performance.
6. Product shall be a standard offering of the fan manufacturer and include published literature with supporting test data to validate sensor performance.

2.04 AIRFLOW TRANSMITTERS

A. Pressure Differential Transmitters for Airflow Measurement:
1. Performance:
   a. Range: As required by application and at least 10 percent below minimum airflow and 10 percent greater than design airflow.
   b. Accuracy: Within 0.5 percent of the full-scale range.
   c. Hysteresis: Within 0.10 percent of full scale.
   d. Repeatability: Within 0.05 percent of full scale.
   e. Stability: Within one percent of span per year.

f. Overpressure: 10 psig.
g. Temperature Limits: Zero to 150 deg F
h. Compensate Temperature Limits: 40 to 150 deg F.
i. Thermal Effects: 0.033 percent of full scale per degree F.
j. Shock and vibration shall not harm the transmitter.

2. Output Signals:
   a. Analog Voltage Signal:
      1) Three wire, zero to 10 V.
      2) Minimum Load Resistance: 1000 ohms.
3. Display: Four-digit digital with minimum 0.4-inch- high numeric characters.
4. Operator Interface:
   a. Zero and span adjustments located behind cover.
5. Construction:
   a. Plastic casing with removable plastic cover.
   b. Fittings: Swivel fittings for connection to copper tubing or barbed fittings for connection to polyethylene tubing. Fittings on bottom of instrument case.
   c. Screw terminal block for wire connections.
   d. Vertical plane mounting.
   e. NEMA 250, Type 4.
   f. Mounting Bracket: Appropriate for installation.

B. Pressure Differential Indicating Transmitter, Switch, and Controller for Airflow Measurement:
1. Description:
   a. Three-in-one instrument, including digital display, control relay switches, and a transmitter with a current output.
   b. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
   c. Select instrument range based on application.
2. Performance:
   a. Accuracy including hysteresis and repeatability:
      1) Ranges Less than 5-Inch wg: Within 1 percent.
      2) Other Ranges: Within 0.5 percent at 77 deg F.
   b. Stability: Within 1 percent per year.
   c. Response Time: 250 ms.
   d. Overpressure:
      3) Ranges Less than 50-Inch wg: 5 psi.
      4) Range of 100-Inch wg: 9 psi.
   e. Temperature Limits: 32 to 140 deg F.
   f. Thermal Effects: 0.020 percent per deg F
   g. Warm-up Period: One hour.
3. Controller: Programming through menu keys to access five menus.
   a. Security level.
   b. Pressure, velocity, or flow application.
   c. Engineering units.
   d. K-factor for use with flow application.
   e. Set-point control only; set-point and alarm operation; alarm operation as high, low, or high/low with manual; or automatic reset and delay.
   f. View high and low readings.
   g. Digital dampening for smoothing erratic applications.
   h. Scaling of analog output to fit range and field calibration.
4. Display:
   a. Four-digit digital, with minimum 0.4-inch-high alphanumeric characters.
   b. Four LED indicators; two LEDs for set point and two LEDs for alarm status.
5. Operator Interface:
   a. Set-point adjustment through keypad on face of instrument.

b. Zero and span adjustments accessible through menu.
c. Programming through keypad.

6. Output Analog Signal: Two-wire, 4- to 20-mA dc current source; capable of operating into a 900-ohm load.
7. Output Digital Signal: Two, SPDT relays; each rated for 1 A at 30-V ac or 30-V dc.
8. Construction:
   a. Die-cast aluminum casing and bezel.
   b. Connections on side and back.
   c. Vertical plane mounting.
   d. NEMA 250, Type 1 rating.
   e. Nominal 4-inch-diameter face.
   f. Mounting Bracket: Appropriate for installation.

2.05 LIQUID FLOW METERS

A. General Requirements for Liquid Flow Meters:
   1. Adjustable for changes in system operational parameters.
   2. Liquid and Steam Sensors, Meters, and Transmitters: Extended range of 10 percent above Project design flow and 10 percent below Project minimum flow to signal abnormal flow conditions.
   3. Manufacturer shall certify that each flow instrument indicated complies with specified performance requirements and characteristics.
   4. Product certificates are required.

B. Insertion Paddle Wheel Flow Meter, NPS 2:
   1. Description: Insertion-type meter with a non-magnetic spinning paddle wheel.
   2. Performance:
      a. Range: 0.5 to 30 fps.
      b. Accuracy: Within 1 percent of full scale over flow range.
      c. Linearity: Within 0.2 percent of full scale over flow range.
      d. Repeatability: Within 0.3 percent of full scale over flow range.
      e. Ambient Temperature: 14 to 150 deg F.
      f. Maximum Process Temperature: 221 deg F.
      g. Maximum Pressure: 400 psig at 100 deg F.
   3. Output Signal: Frequency pulse.
   4. Construction:
      a. Wetted Metal Parts, Including Sensor Sleeve, Mounting Adapter, and Isolation Valve: Brass.
      b. Shaft: Type 316 stainless steel.
      c. Impeller: Nylon.
      d. Process Connection: NPS 2.
      e. Instrument Isolation Valve: Full port ball valve for system isolation.
      f. Insertion Depth: Threaded positioning nut for accurate sensor depth in the pipe.
      g. Electronics Enclosure:
         1) Polyphenylene sulfide (PPS) with Viton seal.
         2) Electrical Connection: Cable furnished with sensor.
   5. Transmitter:
      a. User-adjustable scale to refine resolution of flow range over 4- to 20-mA signal.
      b. Enclosure Material: Polycarbonate with tongue and groove, with neoprene sealed cover.
      c. NEMA 250, Type 4X enclosure.
      d. Electrical Connection: Screw terminals.
      e. Linearity less than one percent.
      f. Output Response Time: 6 seconds for 10 to 90 percent step.
      g. Load resistance of 650 ohms at 24-V dc.
      h. Operating Temperature: Minus 32 to plus 122 deg F.
      i. Digital display of flow rate.

C. Insertion Paddle Wheel Flow Meter, NPS 1:
   1. Description:

a. Insertion-type meter with a non-magnetic spinning paddle wheel.
b. Each meter shall be wet calibrated at factory to standards traceable to NIST and provided with a certificate of calibration.
c. Programming kit including cable connector and Microsoft-Windows-compatible software.
d. Where indicated, provide meter with bi-directional flow measurement.

2. Performance:
a. Range: 0.33 to 20 fps.
b. Accuracy: Within 0.5 percent of flow rate.
c. Repeatability: Within 0.5 percent.
d. Ambient Temperature: 14 to 150 deg F.
e. Maximum Process Temperature: 300 deg F with PEEK sensor tip.
f. Maximum Pressure: 350 psig at 300 deg F with PEEK sensor tip.
g. Pressure Drop: Up to 0.5 psig at 10 fps for pipe sizes NPS 1-1/2 and larger.

3. Output Signal:
a. Unidirectional Flow Meter:
1) Analog, two wire, loop-powered, 4- to 20-mA signal.
b. Bi-Directional Flow Meter:
c. Analog 4- to 20-mA signal plus direction.

4. Operator Interface:
a. Programming: Instrument programming through computer and programming kit.
b. Digital Display: Eight-character digital display of flow rate, flow totalization, input, output, and flow direction for bi-directional meters.

5. Construction:
a. Wetted Metal Parts (Including Sensor Stem, Mounting Adapter, and Isolation Valve): Type 316 stainless steel.
b. Sensor Tip: PPS or PEEK.
c. Shaft: Tungsten carbide.
d. Impeller: Stainless steel.
e. Process Connection: NPS 1.
f. Instrument Isolation Valve: Full port ball valve for system isolation.
g. Insertion Depth: Threaded positioning nut for accurate sensor depth in the pipe.
h. Electronics Enclosure:
1) Polypropylene with Viton-sealed acrylic cover.
2) Removable cover.
3) NEMA 250, Type 4X.
4) Electrical Connection: Screw terminals.
5) Conduit Connection: 1/2-inch trade size.

D. Insertion Turbine Flow Meter:
1. Description:
a. Operating pressure of 300 psig with a temperature of 200 deg F.
b. Meters in hot water systems shall be suitable for maximum system temperatures encountered, but not less than 250 deg F.
c. Pressure drop not to exceed 1 psig at 20-fps flow velocity in a NPS 2 pipe and decreasing in large pipe with lower velocity.
d. Sensor Accuracy:
1) Within 1 percent of actual flow between the flow velocity range of 3 to 30 fps.
2) Within 2 percent of actual flow between the flow velocity range of 0.4 to 20 fps.
3) Within 0.5 percent of actual reading at the calibrated velocity.
e. Wet calibrate and tag sensors to standards traceable to NIST, and provide each sensor with a certificate of calibration.

2. Sensor:
a. For Pipe Sizes NPS 2 and Smaller: Single turbine sensors.
b. For Pipe Sizes NPS 2-1/2 and Larger: Dual turbine sensors.
c. Piping with Bi-directional Flow: Bi-directional dual turbine sensors.

d. Dual turbine sensors shall have dual, contra-rotating turbine elements, each turbine element with its own rotational sensing system, and an averaging circuit.
e. Rotational sensing of each turbine shall be accomplished electronically by sensing electronic impedance change (non-magnetic and non-photoelectric).
f. Sensor shall have an integral frequency output linear with flow rate. For dual turbine units, with individual top and bottom turbine outputs for diagnostic purposes.
g. Bi-directional sensors shall have isolated solid-state dry contacts with a contact rating of 100 mA at 50 V. The contacts shall close when the flow in direction of arrow is 0.18 fps or more.
h. Flow sensor shall be complete with installation hardware necessary to enable insertion and removal from pipe without system shutdown.
i. Construct turbine elements of polypropylene with sapphire jewel bearings and tungsten carbide shafts. Construct wetted metal components of Type 316 stainless steel, including installation hardware.
j. House sensor electronics in a NEMA 250, Type 4 enclosure.
k. Enclosure shall include connection(s) for field-installed conduit.
l. Sensor shall have cable of length sufficient to connect to display module.
m. Sensor housing shall have full port Type 316 stainless steel ball valve for system isolation.

3. Display Module:
a. Remote from sensor.
b. House in a NEMA 250, Type 4X enclosure.
c. Label terminal strip for all wiring connections.
d. 120-V ac power supply with 24-V dc output to power the flow sensor.
e. Remote Interface:
1) Serial Communication Interface: Compatible with host to share flow rate and totalized flow data.
2) Outputs linear to within 0.1 percent of calibrated span.
f. Digital display for flow rate and totalized flow.
1) At least eight display digits for totalization.
2) Bi-directional units with separate digital display for flow and totalization in each direction.
g. Local reset of flow totalization.
h. Program and data shall be stored in nonvolatile memory in event of power loss.
i. For bi-directional units, with display of flow direction (contacts open or closed).

E. Inline Turbine Flow Meter:
1. Description:
a. Available in NPS 3/4 and NPS 1.
b. Operating pressure of 300 psig with a temperature of 200 deg F.
c. Meters in hot water systems shall be suitable for maximum system temperatures encountered, but not less than 250 deg F.
d. Pressure drop not to exceed 3 psig at 38 gpm.
e. Sensor Accuracy:
1) Within 2 percent of actual flow between the flow range of 0.8 to 38 gpm.
2) Within 0.5 percent of actual reading at the calibrated velocity.
f. Wet calibrate and tag sensors to standards traceable to NIST, and provide each sensor with a certificate of calibration.

2. Sensor:
a. Rotational sensing of turbine shall be accomplished electronically by sensing electronic impedance change (non-magnetic and non-photoelectric).
b. Sensor shall have an integral frequency output linear with flow rate.
c. Sensor shall have threaded union on each end.
d. Construct turbine elements of polypropylene with sapphire jewel bearings and tungsten carbide shafts.
e. Construct wetted metal components of brass or stainless steel.
f. House sensor electronics in a NEMA 250, Type 4 enclosure.
g. Enclosure shall include connection(s) for field-installed conduit.

h. Sensor shall have cable of length sufficient to connect to display module.

3. Display Module:
   a. Remote from sensor.
   b. Enclosure: NEMA 250, Type 4X.
   c. Label terminal strip for all wiring connections.
   d. 120-V ac power supply with 24-V dc output to power the flow sensor.
   e. Remote Interface:
      1) Serial Communication Interface: Compatible with host to share flow rate and totalized flow data.
      2) Outputs linear to within 0.1 percent of calibrated span.
   f. Digital display of flow rate and totalized flow.
   g. At least eight display digits for totalization.
   h. Local reset of flow totalization.
   i. Program and data shall be stored in nonvolatile memory in the event of power loss.

F. In-line Body Electromagnetic Flow Meter:
   1. Description:
      a. No moving parts.
      b. Suitable for flow measurement of fluids with electrical conductivity more than 5 micro-Seimens per cm.
      c. Inherent bi-directional flow measurement.
      d. Flow measurement with three pipe diameters upstream and two pipe diameters downstream.
      e. Wet calibrate and tag meters to standards traceable to NIST, and provide each meter with a certificate of calibration.
      f. Transmitter: integral to meter.
   2. Performance:
      a. Accuracy for Velocities between 3.3 and 33 fps: Within 0.2 percent of reading.
      b. Accuracy for Velocities between 1.0 and 3.3 fps: Within 0.75 percent of reading.
      c. Accuracy for Velocities Less than 1.0 fps: Within 0.0075 fps.
      d. Ambient Temperature: Minus 4 to plus 140 deg F.
      e. Process Temperature: Minus 4 to 212 deg F.
      f. Pressure: 225 psig.
   3. Analog Output Current Signal:
      a. Two-wire, 4- to 20-mA dc current source.
      b. Signal capable of operating into 1000-ohm load.
      c. Isolated.
   4. Digital Output Signal: Two, programmable, digital/pulse outputs configurable for frequency, pulse, or directional flow.
   5. Operator Interface:
      a. Keypad.
      b. Digital Display: Multiple-line digital display of alphanumerical characters.
      c. LED for normal and alarm operation.
   6. Construction:
      a. Body: Type 316 stainless steel.
      b. Body Liner Material: PTFE.
      c. Flow Tube: Type 304 stainless steel.
      d. Connection: 150 Class flange.
      e. Electrodes: Type 316 stainless steel. Quantity determined by manufacturer based on application.
      f. Electronics Enclosure:
         1) Painted aluminum.
         2) Removable cover.
         3) NEMA 250, Type 6.

G. Insertion Electromagnetic Flow Meter:

1. Description:
   a. No moving parts.
   b. Suitable for flow measurement of fluids with electrical conductivity between 20 to 60000 micro-Seimens per centimeter.
   c. Suitable for pipe sizes NPS 3 through NPS 72.
   d. Wet calibrate and tag meters to standards traceable to NIST, and provide each meter with a certificate of calibration.
   e. Continuous auto-zero function.
   f. Transmitter integral to meter.
2. Performance:
   a. Flow Range: 0.25 to 20 fps.
   b. Accuracy for Velocities between 2 and 20 fps: Within 1 percent of reading.
   c. Accuracy for Velocities Less than 2 fps: Within 0.02 fps.
   d. Ambient Temperature: Minus 5 to 150 deg F.
   e. Process Temperature: 15 to 250 deg F.
   f. Pressure: 400 psig.
3. Output Signals:
   a. Field-selectable analog signals.
      1) Current Signal (Isolated): 4 to 20 mA.
      2) Voltage Signal (Isolated): Zero- to 10-V dc.
   b. Digital Signal: Dry-contact closure signaling fault condition.
   c. Frequency Signal: Zero- to 15-V peak pulse, zero to 500 Hz.
   d. Scalable Pulse Output:
      1) Isolated solid-state dry contact.
      2) Contact Rating: 100 mA at 50-V dc.
      3) Pulse Duration: 0.5, 1, 2, or 6 seconds.
4. Construction:
   a. Wetted Metal Parts: Type 316 stainless steel.
   b. Sensor Head: Polysulfone.
   c. Process Connection: 1-inch.
   d. Instrument Isolation Valve: Full port Type 316 stainless steel ball valve for system isolation.
   e. Electrodes: Type 316 stainless steel.
   f. Electronics Enclosure:
      1) Painted aluminum.
      2) Removable cover.
      3) NEMA 250, Type 4.
      4) Electrical Connection: PVC-jacketed cable, 10 feet long.
      5) Conduit Connection: 1/2-inch trade size.
5. Display Module:
   a. Remote from meter.
   b. House in a NEMA 250, Type 4X enclosure.
   c. Label terminal strip for all wiring connections.
   d. 120-V ac power supply with 24-V dc output to power the flow sensor.
   e. Input Signal from Meter: Zero- to 15-V pulse output.
   f. Output Signals: Additional output signals furnished with flow meter connected to display module terminal strip.
   g. Auxiliary Output Signals:
      1) Analog voltage output (isolated) shall be zero to 10 V.
   h. Digital Display:
      1) Flow rate.
      2) Totalized flow.
      3) At least six display digits for flow rate and eight display digits for totalization.
      4) Bi-directional units with separate digital display for flow and totalization in each direction.
   i. Local reset of flow totalization.

j. Program and data shall be stored in nonvolatile memory in the event of power loss.
k. For bi-directional units, provide LED display of flow direction (contacts open or closed).

H. Vortex Shedding Flow Meter with Integral Temperature Measurement:
1. Description:
a. Flow measurement using vortex shedder body with integral 1000-ohm platinum RTD.
b. Meter NPS 3/8 through NPS 8.
c. Each meter shall be factory calibrated at five points from zero to 250 fps and tagged accordingly against the manufacturer's flow standards. The manufacturer shall provide a certificate of calibration for meter.
d. Each meter shall be programmed using project-specific application data.
e. Meter shall include integral diagnostics to verify installation conditions and proper operation.
2. Performance:
a. Volumetric Flow Accuracy: Within 1 percent of reading for meter NPS 1and larger; within 2 percent of reading for smaller sizes.
b. Mass Flow Accuracy: Within 1.5 percent of reading for NPS 1 and larger; within 2.5 percent of reading for smaller sizes.
c. Ambient Temperature: Zero to 132 deg F.
d. Process Temperature: 25 to 464 deg F.
e. Pressure: Equal to flange rating.
3. Output Signals:
a. Analog Current Signal of Flow Rate:
1) Two-wire, 4- to 20-mA dc current source.
2) Signal capable of operating into 1000-ohm load.
b. Digital Signal: Pulse output for flow totalization. Two wire, scaled pulse, 0.5 Hz, 100 mA at 30-V dc.
4. Operator Interface:
a. Keypad.
b. Digital Display: Two-line digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, and temperature and support field programming of all parameters.
5. Construction:
a. Material: Type 316L stainless steel for sizes through NPS 4; Type 304 stainless steel for larger sizes.
b. Connection: Class 300 flange.
c. Vortex Shedder: Unalloyed titanium.
d. Shedder Seal: Nickel-plated Inconel.
e. Enclosure:
1) Epoxy-painted cast aluminum.
2) Removable screw-on cover.
3) NEMA 250, Type 4X.
4) Electrical Connection: Screw terminals.
5) Conduit Connection: Two, 1/2-inch trade size.
6. Remote Display Module:
a. Remote from meter.
b. House in a NEMA 250, Type 4 enclosure.
c. Label terminal strip for all wiring connections.
d. 120-V ac power supply with 24-V dc output to power the flow meter.
e. Input Signal from Meter: Analog current, 4 to 20 mA.
f. Output Signals:
1) Analog Current Output: Two wire, 4 to 20 mA, maximum loop resistance 275 ohms.
2) Digital Output (Isolated): Solid-state dry contacts rated for 100 mA at 50-V dc.
g. Digital Display:
1) Flow rate.
2) Totalized flow.
3) Display Digits: 3.5 for flow rate and 8 for totalization.

h. Local reset of flow totalization.
i. Program and data shall be stored in nonvolatile memory in the event of power loss.

7. Upstream Flow Straightener:
   a. Flow straightener where required by installation.
   b. Straightener shall be wafer type, constructed of Type 304 stainless steel, designed to be installed between field-installed flanges.
   c. Straightener size shall match meter size.

I. Vortex Shedding Flow Meter with Integral Pressure and Temperature Measurement:
1. Description:
   a. Mass flow measurement corrected for density using vortex shedder body with integral piezoelectric pressure sensors and 1000-ohm platinum RTD.
   b. Meter NPS 1/2 through NPS 12.
   c. Each meter shall be factory calibrated at five points from Zero to 250 fps and tagged accordingly against the manufacturer's flow standards. The manufacturer shall provide a certificate of calibration for meter.
   d. Each meter shall be programmed using project-specific application data.
   e. Meter shall include integral diagnostics to verify installation conditions and proper operation.
2. Performance:
   a. Volumetric Flow Accuracy for Liquid: Within 0.75 percent of reading for Reynolds numbers 20000 and larger.
   b. Volumetric Flow Accuracy for Steam and Gas: Within 1 percent of reading for Reynolds numbers 20000 and larger.
   c. Mass Flow Accuracy for Steam and Gas: Within 1.5 percent of reading for Reynolds numbers 20000 and larger.
   d. Repeatability: Within 0.1 percent.
   e. Long-Term Stability: Within 0.1 percent per year.
   f. Ambient Temperature: Minus 40 to plus 185 deg F.
   g. Process Temperature: Minus 40 to plus 464 deg F.
   h. Pressure: Equal to flange rating.
3. Output Signals:
   a. Analog Current Signal of Flow Rate:
      1) Two-wire, 4- to 20-mA dc current source.
      2) Signal capable of operating into 1000-ohm load.
   b. Analog Current Signals for Pressure and Temperature: Separate 4- to 20-mA signals for gage pressure and temperature.
   c. Digital Signal:
      1) Pulse output for flow totalization. Two wire, scaled pulse, 0.5 Hz, 100 mA at 30-V dc.
      2) HART, FSK protocol.
4. Operator Interface:
   a. Keypad.
   b. Digital Display: Two-line digital display of alphanumerical characters. The meter shall display flow rate, flow totalization, pressure, temperature, and support field programming of all parameters.
5. Construction:
   a. Material: Type 316L stainless steel.
   b. Connection: Class 150 flange.
   c. Enclosure:
      1) Epoxy-painted cast aluminum.
      2) Removable screw-on cover.
      3) NEMA 250, Type 6.
      4) Electrical Connection: Screw terminals.
      5) Conduit Connection: Two, 1/2-inch trade size.
6. Upstream Flow Straightener:

a. Meter manufacturer shall provide flow straightener where required by installation to comply with manufacturer's installation recommendations.
b. Straightener shall be wafer type, constructed of Type 304 stainless steel, designed to be installed between field-installed flanges.
c. Straightener size shall match meter size.

2.06 LIQUID FLOW SENSORS (PRIMARY ELEMENTS)

A. Averaging Pitot Tubes:
1. Standards: ASME MFC-12M.
2. Description:
a. Sensor shall include isolation valves and connections that are suitable for connecting to a remote pressure instrument.
b. Sensor shall consist of high- and low-pressure plenums and be able to accommodate an integral RTD.
c. Sensor's cross-sectional tee shape shall allow flow separation at a fixed point independent of flow rate, pressure, or temperature with a stable flow coefficient maintained over a wide range of Reynolds numbers.
d. Sensor shape shall promote less-turbulent zones on the backside of the sensor. Individual sensing ports shall be located in this less-turbulent region to measure low pressure. Number of sensing ports shall be a function of the pipe size.
e. High pressure shall be measured by a frontal slot design extending full length of sensor. Number of slots shall be a function of pipe size.
f. Manufacturer shall submit on request independent testing documentation (product test reports), demonstrating compliance with specified performance.
3. Performance:
a. Discharge Coefficient Factor: Within 0.75 percent of flow rate.
b. Repeatability: Within 0.1 percent.
c. Flow Turndown: 10:1.
d. Sensor Size for Pipe Size NPS 2 through NPS 8: Minimum rod Reynolds number of 6000; probe width of 0.59 inch.
e. Process Temperature Limit: 500 deg F.
f. Process Pressure Limit: Equal to flange rating.
4. Construction:
a. Sensor Surface Finish: Front surface textured for high-Reynolds-number applications to create a more turbulent boundary layer on front surface of sensor and produce a more predictable and repeatable separation of flow at edge of sensor.
b. Sensor Material: Type 316 stainless steel.
c. Packing Gland:
1) Wetted Parts: Type 316 stainless steel.
2) Packing Material: Graphite.
d. Isolation Valve: Type 316 stainless steel full port ball valve configured to remove sensor while isolating process.
e. Flanged In-line Pipe Spool:
1) Mount sensor in a flanged section of pipe.
2) Pipe material to match adjacent pipe.
3) Flanges to match adjacent pipe.

B. Venturis:
1. On request, submit independent testing documentation (product test reports), demonstrating compliance with specified performance.
2. Standard: ASME MFC-3M.
3. Performance:
a. Accuracy within 0.5 percent of measured flow throughout flow range from design to 10 percent of design flow.
b. Accuracy with five pipe diameters of straight pipe upstream and two pipe diameters downstream.

c. Size and beta ratio shall be matched with transmitter to provide accuracy of entire assembly within 1 percent of design flow rate, when the flow rate is allowed to vary between 10 to 100 percent of the design.

4. Construction:
   a. One-piece bronze or brass construction with threaded connections for pipe sizes NPS 1/2 through NPS 2.
   b. One-piece plated cast steel with flanged connections for pipe sizes NPS 2-1/2 through NPS 8, and fabricated steel with flanged connections for larger sizes.
   c. Sensing Taps: Two, accurately located built-in sensing taps, nipples, shut-off valves, and quick connect coupling.
   d. Identification Tag: Attached to each venturi with a chain and label indicating pipe size, venturi series, station identification, and meter reading at flow rate and pressure differential.
   e. Use venturi with pressure differential transmitter.

C. Orifice Plates:
1. Standards: ASME MFC-3M or ASME MFC-14M.
2. Performance:
   a. Orifice plates shall be sharp, square-edged concentric type.
   b. Shop fabricate and calibrate orifice meter runs through NPS 2.
   c. Field fabricate orifice runs NPS 3 and larger.
   d. Meter run piping or tubing shall be uniform internal surface, which is free of internal grooves and striations, but is not polished. Out of roundness shall not exceed 0.5 percent. A reduction of the pipe diameter or distortion caused by welding is unacceptable.
   e. Size orifice plates for 100-inch wg pressure differential, except that the absolute value of the meter range shall not exceed the absolute value of the flowing pressure.
   f. Ratio of orifice diameter to actual internal pipe diameter d/B (beta) shall be between 0.70 and 0.30.
   g. Locate orifice plates in horizontal or vertical lines in accordance with good metering practice.
   h. Minimum upstream and downstream straight pipe shall comply with ASME Fluid Meters Research Committee Reports.
3. Construction:
   a. Fabricate the orifice plate and matching companion flanges of Type 316 stainless steel.
   b. Transmitter connection shall be at least NPS 1/2.
   c. Stamp the orifice plates with the number and the orifice bore on the handle of the plate.
4. Use orifice plate with pressure differential transmitter.
5. Calibration information and calculations shall comply with either of the referenced standards for each orifice plate.

D. Segmented Wedge Flow Sensor:
1. Description: Pressure differential design using a segmented or segmental wedge installed in a straight section of pipe.
2. Performance:
   a. Accuracy within 0.5 percent of the measured flow over flow range from design flow to 10 percent of design flow.
   b. Accuracy with 10 pipe diameters of straight pipe upstream and five pipe diameters downstream.
   c. Repeatability shall be within 0.2 percent over flow range.
   d. Discharge coefficient shall be linear and stable throughout the flow range.
   e. Determine H/ID ratios to meet specified performance.
   f. Capable of bi-directional flow measurement with no degradation of performance, with flow in either direction.
   g. Suitable for working pressure of 200 psig at 200 deg F.
3. Construction:
   a. Pipe: Type 316 stainless steel with inside diameter to match adjacent pipe. Length determined by manufacturer.
   b. Wedge: Type 316 stainless steel segmented angled wedge equal on both sides.

c. Flanges: Class 150 weld neck, Type 316 stainless steel.
d. Instrument Connections: NPS 1/2, Class 3000, Type 316 stainless steel half couplings.
e. Identification Tag: Stamped or engraved stainless steel.

4. Use with a pressure differential transmitter.

2.07 LIQUID FLOW SWITCHES

A. Liquid Flow Switch (Magnetic Type):
1. Description:
a. Field-adjustable five-vane combinations.
b. Suitable for pipe sizes NPS 1-1/2 through NPS 20.
c. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
d. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups C and D; Class II, Groups E, F, and G.
2. Performance:
a. Flow Rate Actuation and De-actuation: Varies with vane combination.
b. Pressure Limit: 1000 psig for brass body, 2000 psig for Type 316 stainless steel body.
c. Temperature Range: Minus 4 to plus 275 deg F.
d. Electrical Rating: 10 A at 125/250-V ac.
e. Switch Type: SPDT snap switch.
3. Wetted Parts Construction:
a. Vanes: Type 316 stainless steel.
b. Body: Brass.
c. Magnetic Keeper: Type 316 stainless steel.
d. Process Connection: NPS 1-1/2.
4. Enclosure:
a. Die-cast aluminum alloy.
b. Threaded cover.
c. NEMA 250, Type 4.
d. Electrical Connection: Terminal block.
e. Conduit Connection: 3/4-inch trade size.

B. Liquid Flow Switch (Magnetic Type) for Small-Diameter Pipe:
1. Description:
a. Suitable for pipe sizes NPS 1/2 through NPS 2.
b. Mounting Suitable for Application: Switch vertically mounted in horizontal pipe, or switch horizontally mounted in vertical pipe with flow up.
c. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for hazardous-environment Class I, Groups A, B, C, and D; Class II, Groups E, F, and G.
2. Performance:
a. Flow Rate Actuation and De-actuation: Not adjustable.
b. Pressure Limit of Body: 1000 psig for brass, 2000 psig for Type 303 stainless steel body.
c. Pressure Limit of Tee: 250 psig for brass, 1000 psig for malleable iron, and 2000 psig for forged carbon steel and stainless steel.
d. Temperature Range: Minus 4 to plus 220 deg F.
e. Electrical Rating: 5 A at 125/250-V ac.
f. Switch Type: SPDT snap switch.
3. Wetted Parts Construction (Lower Body):
a. Vanes: Type 301 stainless steel.
b. Body: Brass.
c. Magnet: Ceramic.
d. Process Connection: NPS 1/2.
4. Enclosure (Upper Body):
a. Brass.
b. NEMA 250, Type 4.

c. Electrical Connection: Terminal block.
d. Conduit Connection: 3/4-inch trade size.

5. Integral Mounting Tee Furnished with Switch:
   a. Brass.
   b. Size: Match adjacent pipe.
   c. Connection: Threaded pipe.

2.08 LIQUID FLOW TRANSMITTERS

A. Liquid Pressure Differential Transmitter for Flow Measurement:
   1. Performance:
      a. Range: Approximately 2 times the set point.
      b. Span: Adjustable plus or minus 1 mA, non-interactive.
      c. Accuracy: Within 0.25 percent of full scale.
      d. Maximum Operating Pressure: 2.5 times range.
      e. Temperature Limits: Zero to 175 deg F.
      f. Compensate Temperature Limits: 30 to 150 deg F.
      g. Thermal Effects: 0.02 percent of full scale per degree F.
      h. Response Time: 30 to 50 ms.
      i. Shock and vibration shall not harm the transmitter.
   2. Analog Output Current Signal:
      a. Two wire, 4- to 20-mA dc current source.
      b. Signal capable of operating into 1000-ohm load.
   3. Operator Interface:
      a. Zero and span adjustments located behind cover.
      b. Bleed screws on side of body, two screws on low-pressure side and one screw on high-pressure side, for air in line and pressure cavity.
   4. Construction:
      a. Aluminum and stainless steel enclosure with removable cover.
      b. Wetted parts of transmitter constructed of 17-4 PH or 300 series stainless steel.
      c. NPS 1/4 process connections on side of instrument enclosure.
      d. Knock out for 1/2-inch trade size conduit connection on side of instrument enclosure.
      e. Screw terminal block for wire connections.
      f. NEMA 250, Type 4X.
      g. Mounting bracket shall be suitable for installation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
   1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
   2. Do not begin installation without submittal approval of mounting location.

E. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

F. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTRUMENT APPLICATIONS

A. Thermal Airflow Measurement Stations:
   1. For Air-Ducted/Plenum:
      a. Measured Velocities Greater Than 200 fpm: Thermal airflow measurement station.
      b. Provide a remotely mounted microprocessor-based transmitter at each measurement location.
   2. For Air Terminal Units:
      a. Measured Velocities Greater Than 200 fpm: Thermal airflow measurement station.
      b. Provide a microprocessor-based transmitter at each measurement location.

B. Duct-Mounted Airflow Sensors:
   1. Measured Velocities 500 fpm and Less: Thermal airflow station.
   2. Measured Velocities Greater than 500 fpm: Pitot-tube airflow sensor station or Thermal airflow station.

C. Airflow Switches:
   1. Measured Velocities 400 fpm and Less: Polymer film sail switch.
   2. Measured Velocities Greater than 400 fpm: Stainless steel single-vane switch.

D. Airflow Transmitters for Use with Pitot-Tube-Type Sensors:
   1. Outdoor Air Airflow: Pressure differential transmitter for airflow measurement or Pressure differential indicating transmitter, switch and controller for airflow measurement.
   2. Return Air Airflow: Pressure differential transmitter for airflow measurement or Pressure differential indicating transmitter, switch and controller for airflow measurement.
   3. Supply Air Airflow: Pressure differential transmitter for airflow measurement or Pressure differential indicating transmitter, switch and controller for airflow measurement.

E. Liquid Flow Sensors (Primary Elements):
   1. Chilled Water System, General: Averaging pitot tubes or Venturis or Orifice plates or Segmented wedge.

F. Liquid Flow Meters:
   1. Chilled Water System, General: Insertion paddle wheel transmitter, or Turbine flow meter, or Electromagnetic flow meter, or Vortex shedding flow meter with integral temperature measurement, or Vortex shedding flow meter with integral pressure and temperature measurement.

G. Liquid Flow Switches:
   1. Chilled Water System, General: Magnetic type.

H. Liquid Flow Transmitters:
   1. Chilled Water System, General: Liquid pressure differential transmitter.

3.03 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.04 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."

3.05 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

A. Mounting Location:
   1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
   2. Install switches and transmitters for air and liquid flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
   3. Install liquid and steam flow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
   4. Install airflow switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
   5. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.
   6. Install instruments in steam, liquid, and liquid-sealed-piped services below their process connection point. Slope tubing down to instrument with a slope of 2 percent.
   7. Install instruments in dry gas and non-condensable-vapor piped services above their process connection point. Slope process connection lines up to instrument with a minimum slope of 2 percent.

B. Mounting Height:
   1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
   2. Mount switches and transmitters, located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
      a. Make every effort to mount at 60 inches.

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.06 INSTALLATION OF FLOW INSTRUMENTS

A. Airflow Sensors:
   1. Install sensors in straight sections of duct with manufacturer-recommended straight duct upstream and downstream of sensor.
   2. Installed sensors shall be accessible for visual inspection and service. Install access door(s) in duct or equipment located upstream of sensor, to allow service personnel to hand clean sensors.

B. Liquid and Steam Sensors:
   1. Install sensors in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
   2. Alert manufacturer where installation cannot accommodate recommended clearance, and solicit recommendations for field modifications to installation, such as flow straighteners, to improve condition.
   3. Install pipe reducers for in-line sensors smaller than line size. Position reducers at distance from sensor to avoid interference and impact on accuracy.
   4. Install in-line sensors with flanges or unions to provide drop-in and -out installation.

C. Liquid Flow Meters:

1. Install meters in straight sections of piping with manufacturer-recommended straight piping upstream and downstream of sensor.
2. Install pipe reducers for in-line meters smaller than line size. Install reducers at distance from meter to avoid interference and impact on accuracy.
3. Install in-line meters with flanges or unions to provide drop-in and -out installation.
4. Insertion Meters:
   a. Install system process connections full size of meter connection, but not less than NPS 1. Provide stainless steel bushing if required to mate to system connection.
   b. Install meter in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
   c. In applications where top-dead-center location is not possible due to field constraints, install meter at location along top half of pipe if acceptable by manufacturer for mounting orientation.

D. Liquid Switches:
1. Install system process connection full size of switch connection, but not less than NPS 1. Install stainless steel bushing if required to mate switch to system connection.
2. Install switch in top dead center of horizontal pipe positioned in an accessible location to allow for inspection and replacement.
3. In applications where top-dead-center location is not possible due to field constraints, install switch at location along top half of pipe if switch is acceptable by manufacturer for mounting orientation.

E. Transmitters:
1. Install airflow transmitters serving an air system in a single location adjacent to or within system control panel.
2. Install liquid flow transmitters, not integral to sensors, in vicinity of sensor. Where multiple flow transmitters serving same system are located in same room, co-locate transmitters by system to provide service personnel a single and convenient location for inspection and service.

3.07 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.08 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.09 CHECKOUT PROCEDURES

A. Description:
1. Check out installed products before continuity tests, leak tests, and calibration.
2. Check instruments for proper location and accessibility.
3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

B. Flow Instrument Checkout:
1. Verify that sensors are installed correctly with respect to flow direction.
2. Verify that sensor attachment is properly secured and sealed.
3. Verify that processing tubing attachment is secure and isolation valves have been provided.
4. Inspect instrument tag against approved submittal.
5. Verify that recommended upstream and downstream distances have been maintained.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:
   1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
   2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
   3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
   4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
   5. Provide diagnostic and test equipment for calibration and adjustment.
   6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
   7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
   8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
   9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:
   1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
   2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
   3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:
   1. Check digital signals using a jumper wire.
   2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:
   1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
   2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION 23 09 23.14

SECTION 23 09 23.18

LEAK DETECTION INSTRUMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes the following types of leak-detection switches:
   1. Point-type, leak-detection switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
   1. Operating characteristics, electrical characteristics, and furnished accessories indicating control signal, default control signal with loss of power, and electrical power requirements.
   2. Product description with complete technical data and product specification sheets.
   3. Installation operation and maintenance instructions including factors affecting performance.

1.04 LEAK-DETECTION SWITCHES

A. Point-Type, Leak-Detection Switches:
   1. WE Anderson Series WD2
   2. Features: Audible and visual alarm with relay output for remote indication.
   3. Alarm activated based on change in resistance.
   4. Performance:
      a. Service: Water.
      b. Temperature Limits: 32 to 122 deg F
      c. Switch Type: SPDT relay.
      d. Electric Connection: Cable attached.
   5. Construction: Acrylic, ABS plastic.
   6. Field Power: 24-V ac or dc.

PART 2 - EXECUTION

2.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.02 INSTALLATION, GENERAL

A. Properly support instruments, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

B. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force, or by oversized wrenches.
   3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

C. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

2.03 CONNECTIONS

A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables"for electrical power connections.

2.04 INSTALLATION

A. Mount switches not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

2.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification.

2.06 CHECKOUT PROCEDURES

A. Check installed products before continuity tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation for applicable considerations that impact performance.

2.07 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:
   1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
   2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
   3. Equipment and procedures used for calibration shall meet instrument manufacturer's written recommendations.
   4. Provide diagnostic and test equipment for calibration and adjustment.
   5. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
   6. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
   7. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Digital Signals:
   1. Check digital signals using a jumper wire.
   2. Check digital signals using an ohmmeter to test for contact.

C. Switches: Calibrate switches to make or break contact at set points indicated.

2.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION 23 09 23.18

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Copper tube and fittings.
   2. Steel pipe and fittings.
   3. Joining materials.
   4. Transition fittings.
   5. Dielectric fittings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of the following:
   1. Pipe and tube.
   2. Fittings.
   3. Joining materials.
   4. Transition fittings.

1.04 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.

1.05 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
   1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
   1. Chilled-Water Piping: 150 psig at 73 deg F.
   2. Makeup-Water Piping: 80 psig at 73 deg F.
   3. Condensate-Drain Piping: 180 deg F.
   4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type K and ASTM B88, Type L.

B. DWV Copper Tube: ASTM B306, Type DWV.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. 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.

F. Wrought Copper Unions: ASME B16.22.

G. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
   1. Grooved-End Copper Fittings: ASTM B75, 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 rated for minimum 230 deg F for use with ferrous housing, and steel bolts and nuts; 300 psig minimum CWP pressure rating.

2.03 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

D. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.

E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   1. Material Group: 1.1.
   2. End Connections: Butt welding.
   3. Facings: Raised face.

F. Grooved Mechanical-Joint Fittings and Couplings:
   1. Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47/A47M, Grade 32510 malleable iron; ASTM A53/A53M, Type F, E, or S, Grade B fabricated steel; or ASTM A106/A106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   2. Couplings: Ductile- or malleable-iron housing and EPDM or nitrile gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

G. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.04 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.05 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:
1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.06 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating non-conductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Description:
a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Description:
a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Description:
a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:
1. Description:
a. Standard: IAPMO PS 66.
b. Electroplated steel nipple, complying with ASTM F1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded or grooved.
e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

B. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Makeup-water piping installed aboveground shall be the following:
1. Type L or Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

D. Makeup-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

E. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

F. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

G. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.02 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.03 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the following:
   1. Section 230523.11 "Globe Valves for HVAC Piping."
   2. Section 230523.12 "Ball Valves for HVAC Piping."

3. Section 230523.14 "Check Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.04 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: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads 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. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Plain-End Mechanical-Coupled Joints: Prepare, assemble, and test joints in accordance with manufacturer's written installation instructions.

3.05 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.06 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

B. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for plastic 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. Install hangers for fiberglass 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.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Support vertical runs of copper tubing and steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gauges and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.08 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "HVAC Identification."

3.09 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
   4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
   5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
   1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
   2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
   3. Isolate expansion tanks and determine that hydronic system is full of water.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield

strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

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SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Hydronic specialty valves.
   2. Air-control devices.
   3. Strainers.
   4. Connectors.

B. Related Requirements:
   1. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
   2. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
   3. Section 230523.14 "Check Valves for HVAC Piping" for specification and installation requirements for check valves common to most piping systems.
   4. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product:
   1. Include construction details and material descriptions for hydronic piping specialties.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
   3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.06 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Safety Valves and Pressure Vessels: Shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.01 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:
   1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   2. Ball: Brass or stainless steel.
   3. Plug: Resin.
   4. Seat: PTFE.
   5. End Connections: Threaded or socket.

6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig.
9. Maximum Operating Temperature: 250 deg F.

B. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

C. Automatic Flow-Control Valves:
1. Body: Brass or ferrous metal.
2. Flow Control Assembly, provide either of the following:
a. Piston and Spring Assembly: Corrosion resistant, tamper proof, self-cleaning, and removable.
b. Elastomeric Diaphragm and Polyphenylsulfone Orifice Plate: Operating ranges within 2- to 80-psig differential pressure.
3. Combination Assemblies: Include bronze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow within plus or minus 10 percent, regardless of system pressure fluctuations.
7. Minimum CWP Rating: 175 psig.
8. Maximum Operating Temperature: 250 deg F.

2.02 AIR-CONTROL DEVICES

A. Air Purgers:
1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg F.

2.03 STRAINERS

A. Y-Pattern Strainers:
1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig.

2.04 CONNECTORS

A. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

B. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.

3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

END OF SECTION 23 21 16

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SECTION 23 31 13
DUCT WORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   3. Double-wall rectangular ducts and fittings
   4. Double-wall round ducts and fittings
   5. Sheet metal materials.
   6. Sealants and gaskets.
   7. Hangers and supports.
   8. Insulated flexible ducts.

B. Related Sections:
   1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product:

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, insulation material, and static-pressure classes.
   4. Elevation of top and bottom 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.

1.04 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.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

3. 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.
4. Test for leaks before applying external insulation.
5. Low pressure ductwork shall be tested at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Medium pressure ductwork shall be tested at 3 in w.c. with a leakage class of 6.
7. Give seven days' advance notice for testing.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

E. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

F. Comply with ASTM E96, "Test Methods for Water Vapor Transmission of Materials."

G. Comply with NFPA 90A and NFPA 90B.

H. 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.

2.02 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 316 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, select joint types in accordance with Figure 2-1.
   2. For ducts with longest side 36 inches 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." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

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."

2.03 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 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate 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."

2.04 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.

B. Outer Duct: 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 outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.

C. Transverse Joints: Select joint types and fabricate 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, select joint types in accordance with Figure 2-1.
   2. For ducts with longest side 36 inches 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.

D. 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." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
   1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

G. Inner Duct: Minimum 24-gauge solid galvanized sheet steel.

2.05 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
   1. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
      a. Construct ducts of galvanized sheet steel unless otherwise indicated.
      b. For ducts exposed to weather, construct outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
   2. 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."
   3. 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."
   4. 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."

B. Inner Duct: Minimum 24-gauge solid galvanized sheet steel.

C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   2. Coat insulation with antimicrobial coating.
   3. Cover insulation with polyester film complying with UL 181, Class 1.

D. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

2.06 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A653.
   1. Galvanized Coating Designation: G60.
   2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil 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, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A480, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B209 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 shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested 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: White.

H. Reinforcement Shapes and Plates: ASTM A36, 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-minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.07 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested 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.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
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, 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 shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.08 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.09 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 or aluminized vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: R8.

2.10 FLEXIBLE DUCT CONNECTORS

A. Clamps: Nylon strap in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 EXECUTION

3.01 METAL 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, 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.

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 Dampers" 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. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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 and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

3.02 ADDITIONAL INSTALLATION REQUIREMENTS FOR TYPE 1 COMMERCIAL KITCHEN GREASE HOOD EXHAUST DUCT

A. Install ducts in accordance with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operation"; SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; and SMACNA's "Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines" unless otherwise indicated.

B. Install all ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

C. All ducts exposed to view shall be constructed of stainless steel. All ducts concealed from view shall be stainless steel.

D. All joints shall be welded and shall be telescoping, bell, or flange joint as per NFPA 96.

E. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 20 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings.

F. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.03 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."

3.04 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 thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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 of each elbow and within 48 inches 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.

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.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Dampers."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles. 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."

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

3.08 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use duct cleaning methodology as indicated in NADCA ACR.

C. 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 as recommended by 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.

D. 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.

E. 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.

F. 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, or duct accessories.
   4. 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.

5. Provide drainage and cleanup for wash-down procedures.
6. 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.

3.09 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 FLEXIBLE DUCT 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 terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

F. Install duct test holes where required for testing and balancing purposes.

G. 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.

H. Supporting Flexible Ducts:
   1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
   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 o.c.

END OF SECTION 23 31 13

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SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Duct accessory hardware.
11. Spin in taps
12. Duct liner.

1.03 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 installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Include diagrams for power, signal, and control wiring.

PART 2 PRODUCTS

2.01 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.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Performance:
1. Maximum Air Velocity: 2500 fpm.
2. Maximum System Pressure: 2 inches wg.
3. AMCA Certification: Test and rate in accordance with AMCA 511.
4. Leakage:
a. Class III: Leakage shall not exceed 40 cfm/sq. ft. against 1-inch wg differential static pressure.

C. Construction:
   1. Frame:
      a. Hat shaped.
      b. 18-gauge-thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
   2. Blades:
      a. Multiple single-piece blades.
      b. End pivoted, maximum 6-inch width, 0.025-inch-thick aluminum sheet with sealed edges.
   3. Blade Action: Parallel.

D. Blade Seals: Extruded vinyl, mechanically locked.

E. Blade Axles:
   1. Material: Galvanized steel.
   2. Diameter: 0.20 inch.

F. Tie Bars and Brackets: Galvanized steel.

G. Return Spring: Adjustable tension.

H. Bearings: Synthetic.

2.03 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Performance:
      a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg 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- 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 blade.
      b. Parallel-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized steel; 16 gauge 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. All dampers shall have an insulation standoff bracket and locking quadrant.

B. Low-Leakage, Steel, Manual Volume Dampers:
   1. Performance:
      a. AMCA Certification: Test and rate in accordance with AMCA 511.
      b. Leakage:
         1) Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
   2. Construction:
      a. Linkage: Out of airstream.
      b. Suitable for horizontal or vertical airflow applications.
   3. Frames:
      a. Hat, U, or angle shaped.
      b. Thickness: 16-gauge 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.
   b. Parallel-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized, roll-formed steel; 16 gauge thick.
5. Blade Edging Seals:
   a. Closed-cell neoprene or PVC.
6. Blade Jamb Seals: Stainless steel.
7. Blade Axles: Galvanized steel.
8. Bearings:
   a. Molded synthetic.
   b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
9. Tie Bars and Brackets: Galvanized steel.
10. Locking device to hold damper blades in a fixed position without vibration.

C. Jackshaft:
1. Size: 0.5-inch 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.

D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle, made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.04 CONTROL DAMPERS

A. General Requirements:
1. 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:
3. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
4. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
5. Velocity: Up to 3000 fpm.
6. Temperature: Minus 25 to plus 180 deg F.
7. 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- thick, galvanized sheet steel.
   c. Interlocking, gusseted 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.
   b. Parallel-blade design.
   c. Galvanized steel.

d. 16-gauge- thick single skin.

5. Blade Edging Seals:
6. Replaceable Closed-cell neoprene or PVC.
7. Blade Jamb Seal: Flexible stainless steel, compression type.
8. Blade Axles: 1/2-inch diameter; galvanized steel.
9. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
10. 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 or Fully modulating with fail-safe spring return.
    a. Sufficient motor torque and spring 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.
    b. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental enclosure: NEMA 2.

E. Actuator to be factory mounted and provided with a single-point wiring connection.

F. Controllers, Electrical Devices, and Wiring:
1. Electrical Connection: 24 V, 60 Hz.

2.05 FIRE DAMPERS

A. Type: Static and Dynamic, rated and labelled in accordance with UL 555 by and NRTL.

B. Closing rating in ducts up to 4-inch w.g. static pressure class and minimum 2000fpm velocity.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: Curtain type with blades outside airstream, fabricated with roll-formed galvanized steel; with mitered and interlocking corners, gauge in accordance with UL listing

E. Mounting Sleeve: Factory or field installed, galvanized sheet steel, gauge in accordance with UL listing.

F. Mounting Orientation: horizontal or vertical a indicated.

G. Blades: Roll-formed galvanized sheet steel, interlocking full length steel blade connectors. Material gauge is to be accordance with UL listing.

H. Horizontal dampers: include blade lock and stainless steel closure spring.

I. Heat Responsive Device: Replaceable, 212 deg F rated, fusible link.

2.06 FLANGE CONNECTORS

A. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gauge and Shape: Match connecting ductwork.

2.07 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, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

C. Vane Construction:
   1. Single wall.

2.08 REMOTE DAMPER OPERATORS

A. Description: Cable system designed for remote manual damper adjustment.

B. Tubing: Aluminum.

C. Cable: Steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Steel.

F. Accessories: 7/8 inch diameter threaded cap.

2.09 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- thick galvanized steel or 0.032-inch thick aluminum door panel.
      d. Vision panel.
      e. Hinges and Latches: 1-by-1-inch 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-thick galvanized steel or 0.032-inch-thick aluminum frame.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
      a. 24-gauge-thick galvanized steel or 0.032?inch-thick aluminum door panel.
   2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
   3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
   4. Factory set at 3.0 to 8.0 inches wg.
   5. Doors close when pressures are within set-point range.
   6. Hinge: Continuous piano.
   7. Latches: Cam.
   8. Seal: Neoprene or foam rubber.
   9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.10 FLEXIBLE CONNECTORS

A. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Materials: Flame-retardant or noncombustible fabrics.

D. Coatings and Adhesives: Comply with UL 181, Class 1.

E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd..
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

2.11 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.

2.12 SPIN IN TAPS

A. Tested to meet SMACNA Leakage class 3.

B. Construction:
   1. Galvanized Steel: Comply with ASTM A653 and A924.
   2. Galvanized Coating designation: G-60
   3. Profile: Conical.

C. Damper:
   1. Blade: 24 Ga. Galvanized steel.
   2. Bushings: Nylon.
   3. Shaft: 3/8” solid steel rod.

2.13 DUCT LINER

A. Fibrous-glass duct liner: Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard.”
   1. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
   2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

C. Fiberglass-Free Duct Liner: Made from partially recycled cotton or polyester products and containing no fiberglass. Airstream surface overlaid with fire-resistant facing to prevent surface erosion by airstream, complying with NFPA 90A or NFPA 90B. Treat natural-fiber products with antimicrobial coating.
   1. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature when tested in accordance with ASTM C518.
   2. Surface Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with ASTM E84; certified by an NRTL.
   3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with bevelled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

F. 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.
1. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
2. Butt transverse joints without gaps, and coat joint with adhesive.
3. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
4. 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.
5. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
6. 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.
7. 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.

2.14 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Galvanized Coating Designation: G60.
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 painted finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B209, 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, 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 minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 EXECUTION

3.01 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 backdraft 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.
1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum 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 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 and downstream 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. Control devices requiring inspection.
7. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 230553 "HVAC Identification" to indicate the purpose of access door.

L. Install Fire dampers in accordance with UL listing.

M. All fire dampers shall be installed in the correct direction for access to the damper lock.

N. Install flexible connectors to connect ducts to equipment.

O. Install duct test holes where required for testing and balancing purposes.

3.02 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. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
4. Operate remote damper operators to verify full range of movement of operator and damper.
5. Operate fire dampers to verify full range of movement and that proper heat-response device is installed. Fire dampers are to be tested on initial installation by the mechanical contractor. Dynamic testing of fire dampers is required per NFPA 80.

END OF SECTION 23 33 00

SECTION 23 34 16
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Backward-inclined centrifugal fans, including airfoil and curved blade fans.
   2. Forward-curved centrifugal fans.
   3. Square in-line centrifugal fans.

1.02 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. 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 and for designing vibration isolation bases.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in normal operation, emergency operation, and maintenance manuals with replacement parts listing.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."

D. IECC Compliance: Applicable requirements in IECC 2021 with Louisiana Amendments.

E. Capacities and Characteristics: See schedules

2.02 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Description:
   1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
   2. Factory-installed and -wired disconnect switch.

B. Housings:
   1. Housing Material: Galvanized Stee
   2. Housing Coating: Greenheck, Permatector.
   3. Housing Assembly: Sideplates continuously welded or spot welded or attached by continuous Pittsburgh lock seal or similar seal.

4. Formed panels to make curved-scroll housings with shaped cutoff.
5. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
6. Spun inlet cone with flange.
7. Outlet flange.

C. Wheels:
1. Wheel Configuration: SWSI construction with a precision-spun curved inlet flange and a backplate fastened to shaft with setscrews. Wheels shall be statically and dynamically balanced, and nonoverloading.
2. Wheel and Blade Material: Composite
3. Wheel and Blade Coating: None.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
5. Backward-Inclined Curved Blades:
a. Curved design.
b. Heavy backplate.
c. Single-thickness blades continuously welded at tip flange and backplate.

D. Bearings:
1. Prelubricated and Sealed Shaft Bearings:
a. Self-aligning, pillow-block-type ball bearings.
b. Ball-Bearing Rating Life: ABMA 9, L(10) at 100,000 hours.

E. Motor Enclosure: Open, dripproof.

F. Accessories: See schedule

2.03 FORWARD-CURVED CENTRIFUGAL FANS

A. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

B. Housings:
1. Housing Material: Galvanized Steel.
2. Housing Coating: None.
3. Housing Assembly: Sideplates continuously welded or spot welded or attached by continuous Pittsburgh lock seal or similar seal.
4. Formed panels to make curved-scroll housings with shaped cutoff.
5. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
6. Spun inlet cone with flange.
7. Outlet flange.

C. Wheels:
1. Wheel Configuration: SWSI construction with a curved inlet flange, and a backplate fastened to shaft with setscrews.
2. Wheel and Blade Material: Polypropylene.
3. Wheel and Blade Coating: None.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with setscrews.
5. Forward-Curved Wheels:
a. Black-enameled or galvanized-steel construction with inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow.
b. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with setscrews.

D. Motor Enclosure: Open, dripproof.

E. Accessories: See schedule

2.04 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."

2.05 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. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
   1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Section 230553 "HVAC Identification."

3.02 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

3.03 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.

D. 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."

3.04 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."

3.05 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. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. 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.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.06 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."

3.07 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

3.08 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. Replace damaged and malfunctioning controls and equipment.
3. Fans and components will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 23 34 16

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Digital electronic single duct air terminal units with electric reheat.
   2. Digital electronic single duct air terminal units with no heat
   3. Shut off digital electronic single duct air terminal units with no heat

1.02 ACTION SUBMITTALS

A. Product Data: For each type of air terminal unit.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air terminal units.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.03 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Instructions for resetting minimum and maximum air volumes.
      b. Instructions for adjusting software set points.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a Qualified Electrical Testing Laboratory, and marked for intended location and application.

B. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

D. IECC 2021 with Louisiana Amendments.

2.02 DIGITAL ELECTRONIC SINGLE-DUCT AIR TERMINAL UNITS WITH ELECTRIC REHEAT

A. Approved manufacturer: Titus DESV-EH

B. General: Provide factory-fabricated, perforated double-wall, pressure independent, VAV air terminals as indicated on plan sheets.
   1. Select unit with performance characteristics which match or exceed those indicated on schedule.
   2. Insulation shall be sandwiched between galvanized casing panels.
   3. Air terminals shall be certified under the American Refrigeration Institute (ARI) Standard 880-94 certification program or latest edition and shall carry the ARI seal.

C. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thicknesses:
   1. Steel
      a. Upstream/Downstream Pressure Side: 22-ga.

2. Provide steel control enclosure housing all primary flow controls including actuators, controllers, relays, etc.
3. Provide hanger brackets for attachment of supports.
4. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing.
   a. Provide minimum thickness of 1 inch, 4.0 pcf density fiberglass insulation with an R-value of 3.5 or greater.
   b. Secure lining to prevent de-lamination, sagging, or settling.
   c. Liner shall meet NFPA 90A and UL 181 requirements.
   d. Liner shall meet bacteriological requirements of ASTM C665.
   e. Cover liner surfaces and edges with perforated metal of formed AZ@ strips which enclose and seal all edges. Tape and adhesives shall not be permitted.
5. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjusting, or maintenance.
   a. Provide airtight gasket and quarter-turn latches.
6. Sensor:
   a. Multi-ported of the automatic averaging type and arranged to sense velocity in each of four quadrants of the inlet. Cross type sensors utilizing single point static pressure (low side) sensing are not approved.
   b. Accuracy of the sensor shall be +/-5%.
   c. Ports shall extend through damper tube for connections to piping. Units with internal piping connections shall not be allowed.
   d. A minimum length of straight duct equal to three (3) times the inlet duct diameter shall be installed ahead of the air terminal.
7. Leakage Requirements:
   a. Casings: Construct casings such that when subjected to 2-inch w.g. pressure for low pressure units, and 3.0 inches w.g. pressure for high pressure units, total leakage does not exceed 1% of specified air flow capacity with outlets sealed and inlets wide open.
   b. Dampers: Construct air dampers such that when subjected to 4.0 inches w.g. inlet pressure with damper closed total leakage shall not exceed 2% of specified air flow capacity.
8. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.

D. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing.
   1. Dampers shall be constructed of a single round or elliptical blade composite.
   2. Steel damper blade shall be mechanically attached to the shaft with either threaded fasteners or welded. Rivets shall not be acceptable.
   3. Damper shafts shall be continuous, singular axle across the full inlet diameter, and extending through the terminal casing.
   4. The damper shall have a tear resistant neoprene lip seal around its perimeter to form a tight air seal for full shut-off.
   5. The damper shafts shall rotate in self-lubricating bearings.
   6. Provide pressure independent volume dampers that are calibrated in cfm, factory- adjusted, and marked for specified air capacities.
   7. Provide mechanism to vary air volume thru damper for minimum to maximum, in response from signal from thermostat or temperature sensor/controller. The primary damper fail positions shall be easily re-configured in the field.
   8. Damper shall have a seal capable of providing full shutoff against four inches (4") w.c. with leakage less than two percent (2%) of the nominal rating of the VAV box.
   9. The terminal units are to be provided with an external damper position indicator embossed on the end of the damper shaft for visual indication of the damper position

E. Electric-Resistance Heating Coils: Electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Coils shall be ETL listed. Coils shall be housed in an attenuator section integral with the terminal with element grid recessed from unit discharge a minimum of 5 inches to prevent

damage to elements during shipping and installation. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5 inches apart, staggered for maximum thermal transfer and element life and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices

1. Stage(s): Three.
2. Access door interlocked disconnect switch.
3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable).
4. Airflow switch for proof of airflow.
5. Fuses in terminal box for overcurrent protection (for coils of more than 48 A).
6. Pneumatic-electric switches and relays.
7. Magnetic contactor for each step of control (for three-phase coils).

F. Controls:

1. VAV manufacturer to install, mount, and calibrate VAV controllers provided by controls contractor.
2. Provide Electronic controls, compatible with controls system specified in Section 230923 – “HVAC Controls.”. Coordinate with Controls Contractor.
3. See schedule for units to be provided with a space mounted occupancy sensor.

2.03 DIGITAL ELECTRONIC SINGLE-DUCT AIR TERMINAL UNITS WITH NO HEAT

A. Approved manufacturer: Titus DESV

B. General: Provide factory-fabricated, perforated double-wall, pressure independent, VAV air terminals as indicated on plan sheets.

1. Select unit with performance characteristics which match or exceed those indicated on schedule.
2. Insulation shall be sandwiched between galvanized casing panels.
3. Air terminals shall be certified under the American Refrigeration Institute (ARI) Standard 880-94 certification program or latest edition and shall carry the ARI seal.

C. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thicknesses:

1. Steel
   a. Upstream/Downstream Pressure Side: 22-ga.
2. Provide steel control enclosure housing all primary flow controls including actuators, controllers, relays, etc.
3. Provide hanger brackets for attachment of supports.
4. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing.
   a. Provide minimum thickness of 1 inch, 4.0 pcf density fiberglass insulation with an R-value of 3.5 or greater.
   b. Secure lining to prevent de-lamination, sagging, or settling.
   c. Liner shall meet NFPA 90A and UL 181 requirements.
   d. Liner shall meet bacteriological requirements of ASTM C665.
   e. Cover liner surfaces and edges with perforated metal of formed AZ@ strips which enclose and seal all edges. Tape and adhesives shall not be permitted.
5. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjusting, or maintenance.
   a. Provide airtight gasket and quarter-turn latches.
6. Sensor:
   a. Multi-ported of the automatic averaging type and arranged to sense velocity in each of four quadrants of the inlet. Cross type sensors utilizing single point static pressure (low side) sensing are not approved.
   b. Accuracy of the sensor shall be +/-5%.
   c. Ports shall extend through damper tube for connections to piping. Units with internal piping connections shall not be allowed.

d. A minimum length of straight duct equal to three (3) times the inlet duct diameter shall be installed ahead of the air terminal.

7. Leakage Requirements:
   a. Casings: Construct casings such that when subjected to 2-inch w.g. pressure for low pressure units, and 3.0 inches w.g. pressure for high pressure units, total leakage does not exceed 1% of specified air flow capacity with outlets sealed and inlets wide open.
   b. Dampers: Construct air dampers such that when subjected to 4.0 inches w.g. inlet pressure with damper closed total leakage shall not exceed 2% of specified air flow capacity.
8. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.

D. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing.
1. Dampers shall be constructed of a single round or elliptical blade composite.
2. Steel damper blade shall be mechanically attached to the shaft with either threaded fasteners or welded. Rivets shall not be acceptable.
3. Damper shafts shall be continuous, singular axle across the full inlet diameter, and extending through the terminal casing.
4. The damper shall have a tear resistant neoprene lip seal around its perimeter to form a tight air seal for full shut-off.
5. The damper shafts shall rotate in self-lubricating bearings.
6. Provide pressure independent volume dampers that are calibrated in cfm, factory- adjusted, and marked for specified air capacities.
7. Provide mechanism to vary air volume thru damper for minimum to maximum, in response from signal from thermostat or temperature sensor/controller. The primary damper fail positions shall be easily re-configured in the field.
8. Damper shall have a seal capable of providing full shutoff against four inches (4") w.c. with leakage less than two percent (2%) of the nominal rating of the VAV box.
9. The terminal units are to be provided with an external damper position indicator embossed on the end of the damper shaft for visual indication of the damper position.

E. Controls:
1. VAV manufacturer to install, mount, and calibrate VAV controllers provided by controls contractor.
2. Provide Electronic controls, compatible with controls system specified in Section 230923 – “HVAC Controls.”. Coordinate with Controls Contractor.
3. See schedule for units to be provided with a space mounted occupancy sensor.

2.04 SHUT-OFF ELECTRONIC SINGLE-DUCT AIR TERMINAL UNITS WITH NO HEAT

A. Approved Manufacturer: Titus DESV

B. General: Provide factory-fabricated, perforated double-wall, pressure independent, VAV air terminals as indicated on plan sheets.
1. Select unit with performance characteristics which match or exceed those indicated on schedule.
2. Insulation shall be sandwiched between galvanized casing panels.
3. Air terminals shall be certified under the American Refrigeration Institute (ARI) Standard 880-94 certification program or latest edition and shall carry the ARI seal.

C. Casings: Construct of die-cast aluminum or sheet metal of the following minimum thicknesses:
1. Steel
   a. Upstream/Downstream Pressure Side: 22-ga.
2. Provide steel control enclosure housing all primary flow controls including actuators, controllers, relays, etc.
3. Provide hanger brackets for attachment of supports.
4. Linings: Line inside surfaces of casings with lining material to provide acoustic performance, thermal insulation, and to prevent condensation on outside surfaces of casing.
   a. Provide minimum thickness of 1 inch, 4.0 pcf density fiberglass insulation with an R-value of 3.5 or greater.

b. Secure lining to prevent de-lamination, sagging, or settling.
c. Liner shall meet NFPA 90A and UL 181 requirements.
d. Liner shall meet bacteriological requirements of ASTM C665.
e. Cover liner surfaces and edges with perforated metal of formed AZ@ strips which enclose and seal all edges. Tape and adhesives shall not be permitted.

5. Access: Provide removable panels in casings to permit access to air dampers and other parts requiring service, adjusting, or maintenance.
   a. Provide airtight gasket and quarter-turn latches.
6. Sensor:
   a. Multi-ported of the automatic averaging type and arranged to sense velocity in each of four quadrants of the inlet. Cross type sensors utilizing single point static pressure (low side) sensing are not approved.
   b. Accuracy of the sensor shall be +/-5%.
   c. Ports shall extend through damper tube for connections to piping. Units with internal piping connections shall not be allowed.
   d. A minimum length of straight duct equal to three (3) times the inlet duct diameter shall be installed ahead of the air terminal.
7. Leakage Requirements:
   a. Casings: Construct casings such that when subjected to 2-inch w.g. pressure for low pressure units, and 3.0 inches w.g. pressure for high pressure units, total leakage does not exceed 1% of specified air flow capacity with outlets sealed and inlets wide open.
   b. Dampers: Construct air dampers such that when subjected to 4.0 inches w.g. inlet pressure with damper closed total leakage shall not exceed 2% of specified air flow capacity.
8. Multiple Duct Connectors: For air terminals serving more than one air outlet, provide lined outlet plenum with duct collar, butterfly-type damper, and locking device in each outlet.

D. Air Dampers: Construct of materials that cannot corrode, do not require lubrication, nor require periodic servicing.
1. Dampers shall be constructed of a single round or elliptical blade composite.
2. Steel damper blade shall be mechanically attached to the shaft with either threaded fasteners or welded. Rivets shall not be acceptable.
3. Damper shafts shall be continuous, singular axle across the full inlet diameter, and extending through the terminal casing.
4. The damper shall have a tear resistant neoprene lip seal around its perimeter to form a tight air seal for full shut-off.
5. The damper shafts shall rotate in self-lubricating bearings.
6. Provide pressure independent volume dampers that are calibrated in cfm, factory- adjusted, and marked for specified air capacities.
7. Provide mechanism to open or close the damper, in response from signal from thermostat or temperature sensor/controller. The primary damper fail positions shall be easily re-configured in the field.
8. Damper shall have a seal capable of providing full shutoff against four inches (4") w.c. with leakage less than two percent (2%) of the nominal rating of the VAV box.
9. The terminal units are to be provided with an external damper position indicator embossed on the end of the damper shaft for visual indication of the damper position.

E. Controls:
1. VAV manufacturer to install, mount, and calibrate VAV controllers provided by controls contractor.
2. Provide Electronic controls, compatible with controls system specified in Section 230923 – “HVAC Controls.”. Coordinate with Controls Contractor.
3. See schedule for units to be provided with a space mounted occupancy sensor.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Comply with Section 230529 "Hangers and Supports for HVAC Piping and Equipment" and Section 233113 "Metal Ducts" for hangers and supports.

B. Install air terminal units according to NFPA 90A.

C. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

D. Install wall-mounted thermostats.

3.02 DUCTWORK CONNECTIONS

A. Comply with requirements in Section 233113 "Ductwork" for connecting ducts to air terminal units.

B. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.03 ELECTRICAL CONNECTIONS

A. Install field power to each air terminal unit electrical power connection. Coordinate with air terminal unit manufacturer and installers.

B. Connect wiring in accordance with Electrical Specifications.

C. Ground equipment in accordance with Electrical Specifications.

D. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

E. 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 with a black background and engraved white letters at least **1/2 inch** high.

3.04 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Electrical Specifications.

3.05 IDENTIFICATION

A. Label each air terminal unit with drawing designation, nominal airflow, maximum and minimum factory-set airflows**,** and coil type. Comply with requirements in Section 230553 "HVAC Identification" for equipment labels.

3.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.07 ADJUSTING

A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air terminal unit testing, adjusting, and balancing.

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Air terminal unit will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00

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SECTION 23 37 13
AIR INLETS AND OUTLETS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Square plaque ceiling diffusers
   2. Curved blade diffuser
   3. Fixed face supply registers
   4. Perforated Supply Grille
   5. Fixed face return/exhaust grilles
   6. Fixed face transfer grilles
   7. Linear bar grilles
   8. Louvers

1.03 RELATED REQUIREMENTS

A. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

B. Section 233113 “Ductwork”.

1.04 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.

PART 2 PRODUCTS

2.01 SQUARE PLAQUE CEILING DIFFUSERS

A. Manufacturer: Titus model Omni.

B. Material: Steel.

C. Finish: Baked enamel, color selected by Architect.

D. Face Size: See Schedule

E. Duct Inlet: See schedule

F. Mounting: Surface.

G. Pattern: See Schedule

2.02 CURVED BLADE DIFFUSERS

A. Manufacturer:: Titus model 250-AA

B. Material: Aluminum.

C. Finish: As selected by Architect.

D. Face Size: See Schedule

E. Duct Inlet: See schedule

F. Mounting: Surface.

G. Pattern: See Schedule

2.03 FIXED FACE SUPPLY REGISTER

A. Manufacturer: Titus model 301FL
B. Material: Steel
C. Finish: Baked enamel, color selected by Architect.
D. Face Blade Arrangement: Horizontal spaced 3/4 inch apart
E. Deflection: Single, 0 degrees.
F. Core Construction: Integral
G. Frame: 1-1/4 inches wide
H. Mounting: Surface mount with Countersunk screw

2.04 PERFORATED SUPPLY GRILLE

A. Manufacturer: Titus model PAS-AA
B. Material: Aluminum
C. Finish: Baked enamel, color selected by Architect.
D. Face Size: See schedule
E. Duct Inlet: See schedule
F. Discharge Pattern: 4-way, unless otherwise indicated.
G. Core Construction: Integral
H. Mounting: Surface

2.05 FIXED FACE RETURN/EXHAUST GRILLE

A. Manufacturer: Titus model 25RL
B. Material: Steel
C. Finish: Baked enamel, color selected by Architect.
D. Face Blade Arrangement: Horizontal, spaced 1/2 inch apart
E. Deflection: 30 degrees.
F. Core Construction: integral
G. Frame: 1-1/4 inch wide
H. Mounting: Surface mount with Countersunk screw

2.06 FIXED FACE RETURN/EXHAUST FILTER GRILLE

A. Manufacturer: Titus model 23RFL
B. Material: Steel
C. Finish: Baked enamel, color selected by Architect.
D. Face Blade Arrangement: Horizontal, spaced 3/4 inch apart
E. Deflection: 45 degrees.
F. Core Construction: integral
G. Frame: 1-1/4 inch wide
H. Filter Frame: 1 inch wide
I. Mounting: Surface mount with Countersunk screw
J. Filter Thickness: 1 inch

2.07 FIXED FACE TRANSFER GRILLE

A. Manufacturer:: Titus model 350 FL

B. Material: Aluminum
C. Finish: Baked enamel, color selected by Architect.
D. Face Blade Arrangement: Horizontal spaced 3/4 inch apart. Blades in the long direction.
E. Deflection: Single, 35 degrees.
F. Core Construction: Integral
G. Frame: 1-1/4 inches wide. As selected by architect.
H. Mounting: Surface mount with countersunk screw

2.08 LINEAR BAR GRILLES

A. Manufacturer: Titus model CT-580
B. Material: Aluminum
C. Finish: Baked enamel, color selected by architect.
D. Face Blade Arrangement: Horizontal, spaced 1/2 inch apart.
E. Deflection: 0 degree.
F. Face Arrangement: Perforated core.
G. Core Construction: Removable.
H. Frame: See Architectural plans.
I. Mounting: Countersunk screw.
J. See plans for continuous length.
K. Accessories:
    1. Provide blankoffs. See plans for location.
    2. Provide mitered corners.
    3. Field fabricated plenum box. See plans for dimensions.

2.09 LOUVERS

A. Manufacturer: Ruskin model ELF6375DXD
B. Description: Drainable stationary louver. Miami Dade approved, AMCA 540 and 550 certified.
C. Material: Aluminum
D. Frame depth: 6 inches
E. Finish: As selected by Architect.
F. Face Blade Arrangement: Horizontal. At 37.5 degree angle.
G. See schedule for performance data.
H. Mounting: See Architectural plans for details.
I. Provide with insect screen and bird screen

2.10 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

3.01 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.

3.02 INSTALLATION

A. Install diffusers level and plumb.

B. Install registers and grilles level and plumb.

C. Install louvers level and plumb.

D. 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.

E. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

F. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

G. Install louvers with air tight connections to plenums.

3.03 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

B. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 43 00
OZONE CLEANERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Ozone Cleaners

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: For each electronic air cleaner.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Show filter assembly, dimensions, materials, and methods of assembly of components.
   3. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
   4. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of ozone cleanerto include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 CAPACITIES AND CHARACTERISTICS

A. See schedule for information.

2.02 OZONE CLEANERS

A. Manufacturer: AirMade ozone cleaning system

B. Description: Electronic ozone cleaning system to scrub kitchen exhaust air.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Ozone Cleaners and conditions for compliance with requirements for installation tolerances another conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Ozone Cleaners per manufacturer’s written instructions. Provide all accessories as directed by the manufacturer and as shown on plans.

B. Coordinate interlocking with kitchen hood exhaust with kitchen hood installer.

3.03 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 with the assistance of a factory-authorized service representative.

C. Ozone cleaner and associated filters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.04 PROTECTION

A. Protect installed products and accessories from damage during construction.

END OF SECTION 23 43 00

SECTION 23 73 13.16
INDOOR, SEMI-CUSTOM AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulated, double-wall-casing, indoor, semi-custom air-handling units that are factory assembled using multiple section components.

1.03 ACTION SUBMITTALS

A. Product Data: For each air-handling unit.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   3. Incude 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 dampers, including housings, linkages, and operators.

B. Shop Drawings: For each type and configuration of indoor, semi-custom air handling unit.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly of indoor, semi-custom air-handling units, as well as procedures and diagrams.
   4. Include diagrams for power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) for each air-handling unit.
   2. Gaskets: One set(s) for each access door.
   3. Fan Belts: One set(s) for each air-handling unit fan.

1.06 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of indoor, semi-custom air-handling units that fail in materials or workmanship within the warranty period.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units 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/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. IECC 2021 with Louisiana Amendments.

2.02 CAPACITIES AND CHARACTERISTICS

A. See schedule for information

2.03 DESCRIPTION

A. Configuration: Fabricate as detailed on drawings.

B. Performance: Conform to AHRI 430. See schedules on prints.

C. Acoustics: Sound power levels (dB) for the unit shall not exceed the specified levels shown on the unit schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.

2.04 UNIT CONSTRUCTION

A. Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

B. Panels and access doors shall be constructed as a 2-inch nominal thick; thermal broke double wall assembly, injected with foam insulation with an R-value of not less than R-13.
   1. The inner liner shall be constructed of G90 galvanized steel.
   2. The outer panel shall be constructed of G90 galvanized steel.
   3. The floor plate shall be constructed as specified for the inner liner.
   4. Unit will be furnished with solid inner liners.

C. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, maximum 5 inches of positive or 6 inches of negative static pressure. Deflection shall be measured at the panel midpoint.

D. The casing leakage rate shall not exceed 0.50 cfm per square foot of casing surface area at design static pressure up to a maximum of +5” w.c. in positive pressure sections and -6” w.c. in negative pressure sections.

E. Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

F. Access doors shall be flush mounted to cabinetry, with minimum of two six inch long stainless steel piano-type hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

G. A 6-inch formed G60 galvanized steel base rail shall be provided by the unit manufacturer for structural rigidity and condensate trapping..The base rail shall be constructed with 12-gauge nominal for unit sizes 003 - 035 and 10-gauge nominal for unit sizes 040 - 090. The following calculation shall determine the required height of the baserail to allow for adequate drainage. Use the largest pressure to determine base rail height. [(Negative)(Positive) static pressure (in)] (2) + 4” = required baserail height. Should the unit baserail not be factory supplied at this height, the contractor is required to supply a concrete housekeeping pad to make up the difference.

H. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection. Provide drain pans under cooling coil section. Drain connection centerline shall be a minimum of 3’’ above the base rail to aid in proper condensate trapping. Drain connections that protrude from the base rail are not acceptable. There must be a full 2’’ thickness of insulation under drain pan.

2.05 FAN ASSEMBLIES

A. Provide ECM, motorized impeller fan(s). Fan assembly shall include fan, fan base, and a motor and shall be dynamically balanced by the fan manufacturer,
   1. Motor control panel shall come with a low voltage terminal strip and shall include terminals for Fan ON/OFF, 0-10V signal, and fan fault.
   2. Motor control panel shall come equipped with a fused disconnect.
   3. Fan section shall come equipped with a motor control panel mounted on the fan section. Both line voltage and low voltage wiring shall be done by the factory. Each fan shall have an isolation switch.
   4. Motor shall be brushless DC type with a permanent magnet rotor.
   5. Inverter shall be integral to the motor and come as an assembly from the fan manufacturer.

2.06 BEARINGS, SHAFTS, AND DRIVES

A. Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

2.07 ELECTRICAL

A. The air handler(s) shall be ETL and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

B. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.

C. Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.

D. Installing contractor shall provide GFI receptacle within 25 feet of unit to satisfy National Electrical Code requirements.

2.08 COOLING AND HEATING COILS

A. Certification: Acceptable water cooling coils shall be certified in accordance with AHRI Standard 410 and bear the AHRI label. Coils exceeding the scope of the manufacturer's certification and/or the range of AHRI's standard rating conditions will be considered provided the manufacturer is a current member of the AHRI Forced Circulation Air-Cooling and Air-Heating Coils certification programs and that the coils have been rated in accordance with AHRI Standard 410. Manufacturer must be ISO 9002 certified.

B. Water cooling coil shall be provided. Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 5" beyond unit casing for ease of installation. Drain and vent connections shall be provided exterior to unit casing. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.
   1. Headers shall consist of seamless copper tubing to assure compatibility with primary surface. Headers to have intruded tube holes to provide maximum brazing surface for tube to header joint, strength, and inherent flexibility. Header diameter should vary with fluid flow requirements.
   2. Fins shall have a minimum thickness of 0.0075 inch aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.
   3. Coil tubes shall be 5/8 inch OD seamless copper, 0.020 inch nominal tube wall thickness, expanded into fins, brazed at joints.
   4. Coil connections shall be carbon steel, NPT threaded connection. Connection size to be determined by manufacturer based upon the most efficient coil circuiting. Vent and drain fittings shall be furnished on the connections, exterior to the air handler. Vent connections provided at the

highest point to assure proper venting. Drain connections shall be provided at the lowest point to insure complete drainage and prevent freeze-up.

5. Coil casing shall be a formed channel frame of stainless steel.

2.09 FILTERS

A. Furnish flat panel filter section with 2-inch filter. Provide side loading and removal of filters.

B. Filter media shall be UL 900 listed, Class I or Class II.

2.10 ELECTRIC HEAT

A. PRE-HEAT COIL

1. The air handling unit shall include a UL recognized slip-in style electric heat section. See schedule for information.
2. Open coil heating elements shall be 80% nickel and 20% chromium; steps shall be arranged to prevent stratification when operating at less then full capacity. Elements for draw-through air handling units shall be derated to 35 watts per square inch.
3. Element terminals shall be stainless steel; insulators and bracket bushings shall be nonporous ceramic and securely positioned. Terminals shall be machined crimped to elements.
4. Frame should be constructed of heavy gauge galvanized steel with galvanized steel brackets, stiffening ribs and gussets spot welded to the frame.
5. Terminal box shall be spot welded construction with solid, hinged cover, totally enclosed, without louvers or grilles per the UL standard.
6. Airflow direction shall be scheduled. Heater control panel shall be located on same side of unit as drive on fan.
7. Safety devices: a disc-type automatic reset thermal cutout, pressure differential airflow switch, and door interlock switch shall be furnished for primary over temperature protection. All safety devices shall be serviceable through the terminal box without removing the heater from the unit.
8. Wiring Diagrams: a unique wiring diagram shall be furnished for each heater. Diagram shall include recommended supply wire gauges per NEC and fuse sizes. Typical Wiring Diagrams are not acceptable.
9. Built-in components shall include safety devices, disconnecting break magnetic contactors, transformer with primary fusing per UL, pressure type airflow switch set at .05" WC, supplementary circuit fuses per NEC, and separate load and terminal blocks to accept conductors as shown on the electrical plan.
10. The following control type shall be available: SCR 0-10 VDC.

B. RE-HEAT COIL

1. Electric Re-heat shall be provided by an inline, slip-in duct heater. See schedule for information.

2.11 PLENUM

A. Plenum section shall be provided and properly sized for inlet and/or discharge air flow. The plenum shall provide single or multiple openings as shown on drawings and project schedule.

2.12 ACCESSORIES

A. Provide a stainless steel auxiliary drain pan under the unit. Piped to the nearest indirect waste receptacle.

B. Provide controls systems in accordance with section 230923 – "HVAC Controls" and per plans.

C. See schedule and plans for additional accessories.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for steam, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Equipment Mounting:
   1. Install unit per manufacturer's installation instructions. Contractor shall coordinate with all trades and existing conditions to ensure that all manufacturer required clearances are met.
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

D. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

E. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."

3.03 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 air-handling unit, allow for service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using ASTM B88, Type M copper tubing. Pipe full size to the nearest indirect waste receptacle. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Chilled-Water and Condensate Piping: Comply with applicable requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

3.04 ELECTRICAL CONNECTIONS

A. Connect wiring according to Electrical Specifications

B. Ground equipment according to Electrical Specifications.

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 shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.05 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Electrical Specification.

3.06 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
6. Verify that zone dampers fully open and close for each zone.
7. Verify that face-and-bypass dampers provide full face flow.
8. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
9. Comb coil fins for parallel orientation.
10. Verify that proper thermal-overload protection is installed for electric coils.
11. Install new, clean filters.
12. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
2. Measure and record motor electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.07 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.

3.08 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.09 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. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

END OF SECTION 23 73 13.16

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SECTION 26 00 10
SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.02 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.EV: Electric vehicle.
36. EVPE: Electric vehicle power export equipment.
37. EVSE: Electric vehicle supply equipment.
38. 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.
39. FLC: Full-load current.

40. ft: Foot.
41. 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,"
42. GEC: Grounding electrode conductor.
43. GFCI: Ground-fault circuit interrupter.
44. GFPE: Ground-fault protection of equipment.
45. GND: Ground.
46. HACR: Heating, air conditioning, and refrigeration.
47. HDPE: High-density polyethylene.
48. HID: High-intensity discharge.
49. HP or hp: Horsepower.
50. HVAC: Heating, ventilating, and air conditioning.
51. Hz: Hertz.
52. IBT: Intersystem bonding termination.
53. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
54. IP: Ingress protection rating (enclosures); Internet protocol (communications).
55. IR: Infrared.
56. IS: Intrinsically safe.
57. IT&R: Inspecting, testing, and repair.
58. ITE: Information technology equipment.
59. kAIC: Kiloampere interrupting capacity.
60. kcmil or MCM: One thousand circular mils.
61. kV: Kilovolt.
62. kVA: Kilovolt-ampere.
63. kVAr or kVAR: Kilovolt-ampere reactive.
64. kW: Kilowatt.
65. kWh: Kilowatt-hour.
66. LAN: Local area network.
67. lb: Pound (weight).
68. lbf: Pound (force).
69. LCD: Liquid-crystal display.
70. LCDI: Leakage-current detector-interrupter.
71. LED: Light-emitting diode.
72. Li-ion: Lithium-ion.
73. lm: Lumen, the SI derived unit of luminous flux.
74. LNG: Liquefied natural gas.
75. LP-Gas: Liquefied petroleum gas.
76. LRC: Locked-rotor current.
77. LV: Low voltage.
78. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
79. m: Meter.
80. MCC: Motor-control center.
81. MDC: Modular data center.
82. MG set: Motor-generator set.
83. MIDI: Musical instrument digital interface.
84. MLO: Main lugs only.
85. MV: Medium voltage.
86. MVA: Megavolt-ampere.
87. mW: Milliwatt.
88. MW: Megawatt.
89. MWh: Megawatt-hour.
90. NC: Normally closed.
91. Ni-Cd: Nickel-cadmium.
92. Ni-MH: Nickel-metal hydride.

93. NIU: Network interface unit.
94. NO: Normally open.
95. NPT: National (American) standard pipe taper.
96. OCPD: Overcurrent protective device.
97. ONT: Optical network terminal.
98. PC: Personal computer.
99. PCS: Power conversion system.
100. PCU: Power-conditioning unit.
101. PF or pf: Power factor.
102. PHEV: Plug-in hybrid electric vehicle.
103. PLC: Programmable logic controller.
104. PLFA: Power-limited fire alarm.
105. PoE: Power over Ethernet.
106. PV: Photovoltaic.
107. PVC: Polyvinyl chloride.
108. pW: Picowatt.
109. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
110. RMS or rms: Root-mean-square.
111. RPM or rpm: Revolutions per minute.
112. SCADA: Supervisory control and data acquisition.
113. SCR: Silicon-controlled rectifier.
114. SPD: Surge protective device.
115. sq.: Square.
116. SWD: Switching duty.
117. TCP/IP: Transmission control protocol/Internet protocol.
118. TEFC: Totally enclosed fan-cooled.
119. TR: Tamper resistant.
120. TVSS: Transient voltage surge suppressor.
121. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
122. UL CCN: UL Category Control Number.
123. UPS: Uninterruptible power supply.
124. USB: Universal serial bus.
125. UV: Ultraviolet.
126. V: Volt, unit of electromotive force.
127. V(ac): Volt, alternating current.
128. V(dc): Volt, direct current.
129. VA: Volt-ampere, unit of complex electrical power.
130. VAR: Volt-ampere reactive, unit of reactive electrical power.
131. VFC: Variable-frequency controller.
132. VOM: Volt-ohm-multimeter.
133. VPN: Virtual private network.
134. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
135. W: Watt, unit of real electrical power.
136. Wh: Watt-hour, unit of electrical energy usage.
137. WPT: Wireless power transfer.
138. WPTE: Wireless power transfer equipment.
139. 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.
7. EPEC-40: Schedule 40 electrical HDPE underground conduit.
8. EPEC-80: Schedule 80 electrical HDPE underground conduit.
9. EPEC-A: Type A electrical HDPE underground conduit.
10. EPEC-B: Type B electrical HDPE underground conduit.
11. ERMC: Electrical rigid metal conduit.
12. ERMC-A: Aluminum electrical rigid metal conduit.
13. ERMC-S: Steel electrical rigid metal conduit.
14. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
15. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
16. ERMC-SS: Stainless steel electrical rigid metal conduit.
17. FMC: Flexible metal conduit.
18. FMC-A: Aluminum flexible metal conduit.
19. FMC-S: Steel flexible metal conduit.
20. FMT: Steel flexible metallic tubing.
21. FNMC: Flexible nonmetallic conduit. See "LFNC."
22. HDPE: See EPEC.
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 ERMC-S-G.
38. RMC: See ERMC.
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. SEOOW: 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. SJOOW: 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. STOOW: 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. Direct Buried: Installed underground without encasement in concrete or other protective material.
8. 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 enclosures 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.

9. 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.
10. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
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 non-metallic 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.

1.03 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 Architect no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Architect's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
a. Exercising generators.
b. Emergency lighting.
c. Elevators.
d. Fire-alarm systems.

B. Arrange to provide temporary electrical service in accordance with requirements specified in Division 01.

1.04 PREINSTALLATION MEETINGS

A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
1. Electrical installation schedule.
2. Status of power system studies.
3. Value analysis proposals and requests for substitution of electrical equipment.
4. Utility work coordination and class of service requests.
5. Commissioning activities.
6. Sustainability activities.

1.05 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.06 ACTION SUBMITTALS

A. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 01 31 00 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
2. Structural members to which equipment and suspension systems will be attached.
3. Size and location of access panels on ceilings.
4. Elevation, size, and route of sprinkler piping.
5. Elevation, size, and route of plumbing piping.
6. Elevation, size, and route of ductwork.
7. Elevation, size, and route of cable tray.
8. Elevation, size, and route of conduit.
9. Elevation and size of wall-mounted and ceiling-mounted equipment.
10. Access panels.
11. Sprinklers.
12. Air inlets and outlets.
13. Control modules.

14. Luminaires.
15. Communications devices.
16. Speakers.
17. Security devices.
18. Fire-alarm devices.
19. Indicate clear dimensions for maintenance access in front of equipment.
20. Indicate dimensions of fully-open access doors.

B. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved. Contractor shall be responsible for any and all rework of conduit that has not been coordinated with other trades or existing conditions:

C. Structural members in paths of conduit groups with common supports.

D. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

1.07 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:
      a. Panelboards.
   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. 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.

1.08 FIELD CONDITIONS

A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 26 00 11 "Facility Performance Requirements for Electrical."

PART 2 PRODUCTS

2.01 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. 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Verify Existing Equipment and Panel Loads.

3.02 PREPARATION

A. Protection of In-Place Conditions.

3.03 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.

3.04 MATERIALS AND WORKMANSHIP

A. All materials, unless otherwise specified, shall be current manufacture, new, free from all defects, and of the best quality.

B. Materials and equipment shall be installed in accordance with the manufacturers' recommendations and the best standard practice for the type of work involved. All work shall be executed by electricians skilled in their respective trades, and the installations shall present a neat, precise appearance.

C. The responsibility for the furnishing and intended installation of the proper electrical equipment and/or material as intended rests entirely upon the Contractor. The Contractor shall request advice and supervisory assistance from the representative of specific manufacturers during the installation.

3.05 CLEANING AND PAINTING

A. The contractor shall keep the premises free from accumulations of waste material at all times.Debris shall be removed from the site and from any street or alley adjacent to the site.

B. Thoroughly clean and touch up the finish on all parts of the materials and equipment. Exposed parts in equipment rooms, and all other spaces except sealed chases and attics shall be thoroughly cleaned of cement, plaster, and other materials shall be removed. All surfaces shall be carefully wiped, and all cracks and corners scraped out.

C. Exposed metal work which is not galvanized shall be carefully brushed down with steel brushes to remove rust and other spots and left smooth and clean and then painted with a suitable rust resistant primer. Exposed metal work includes work exterior to the building; exposed in mechanical or electrical equipment rooms and storage rooms; and other areas where occupants could see the work, whether normally occupied or not.

D. All other painting shall be accomplished under the Division 9 of the specifications.

E. At completion of the project, the Contractor shall remove all tools, scaffolding, and surplus materials. Contractor shall leave the area clean and ready for occupancy. Before final acceptance, vacuum all panels, switchboards, starters, and other electrical devices. Wipe clean all fixture lenses and reflectors, all panel board and switchboard interior and exterior surfaces, remove all stray paint, construction materials, dust, and particles. Touch-up all marred surfaces to restore existing conditions to those provided by the manufacturer.

END OF SECTION 26 00 10

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SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Copper building wire.
2. Aluminum building wire.
3. Fire-alarm wire and cable.
4. Connectors and splices.

B. Related Requirements:
1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS

PART 2 PRODUCTS

2.01 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable; Prysmian Group North America.
2. Southwire Company.
3. WESCO.

C. 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."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
5. Type THHN and Type THWN-2: Comply with UL 83.
6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
7. Type UF: Comply with UL 83 and UL 493.
8. Type XHHW-2: Comply with UL 44.

F. Shield:

G. Type TC-ER: Cable designed for use with ASDs, with oversized cross linked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.02 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. General Cable; Prysmian Group North America.

2. Southwire Company.
3. WESCO.

C. 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."

D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

E. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
5. Type THHN and Type THWN-2: Comply with UL 83.
6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
7. Type XHHW-2: Comply with UL 44.

2.03 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Wire & Cable Inc.
2. CommScope, Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG size as recommended by system manufacturer.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.04 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
2. ABB, Electrification Business.
3. AFC Cable Systems; Atkore International.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper Aluminum Bronze.
2. Type: One hole with long barrels.
3. Termination: Compression.

PART 3 EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:
   1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
   2. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be 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.
   2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 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.

E. PV Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-On-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: 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 or MC cable.

G. Branch Circuits Concealed in Concrete, below Slabs-On-Grade, and Underground: 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.

3.03 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. MC Cable not permitted unless otherwise noted.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in conduit where exposed and support per NFPA/NEC in concealed spaces.
   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 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.

3.05 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.
1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch of slack.

D. Comply with requirements in Section 28 46 21.11 "Addressable Fire-Alarm Systems" for connecting, terminating, and identifying wires and cables.

3.06 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "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.

3.07 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 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.08 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 07 84 13 "Penetration Firestopping."

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Foundation steel electrodes.

B. Related Requirements:
   2. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Ground rings.
   3. Grounding arrangements and connections for separately derived systems.

1.04 CLOSEOUT SUBMITTALS

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 MANUFACTURERS

2.03 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inch in cross section, with 9/32-inch holes spaced 1-1/8 inch apart. Stand-off insulators for mounting must comply with UL 891 for use in switchboards, 600 V and must be Lexan or PVC, impulse tested at 5000 V.

2.04 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Compression-Type Bus-Bar Connectors: Copper or copper alloy, with two wire terminals.

C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

D. Conduit Hubs: Mechanical type, terminal with threaded hub.

E. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

F. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

G. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.

H. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

I. Water Pipe Clamps:
   1. Mechanical type, two pieces with stainless steel bolts.
      a. Material: Die-cast zinc alloy.
      b. Listed for direct burial.

2.05 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 ft.

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
   1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48-inch long.
   2. Backfill Material: Electrode manufacturer's recommended material.

C. Ground Plates: 1/4-inch-thick, hot-dip galvanized.

PART 3 EXECUTION

3.01 APPLICATIONS

A. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

B. 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 minimum from wall, 6 inch 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.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors must be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode must be connected to the equipment grounding conductor and to the frame of the generator.

3.04 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. 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.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

E. Metallic Fences: Comply with requirements of IEEE C2.
   1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
   2. Gates: Must be bonded to the grounding conductor with a flexible bonding jumper.
   3. Barbed Wire: Strands must be bonded to the grounding conductor.

3.05 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. Use exothermic welds for all below-grade connections.
   3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except were routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

E. 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 a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
   2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
   3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft. apart.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
   1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches from building's foundation.

I. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 ft. of bare copper conductor not smaller than No. 4 AWG.
   1. If concrete foundation is less than 20 ft. long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

J. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
   1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
   2. Make connections with clean, bare metal at points of contact.
   3. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
   4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
   5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.06 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 a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
5. Grounding system will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

C. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Support, anchorage, and attachment components.
   2. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. 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 Submittal: For hangers and supports for electrical systems.
   1. Include design calculations and details of hangers.

1.03 INFORMATIONAL SUBMITTALS

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch diameter holes at a maximum of 8 inch 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: Stainless steel, Type 304.
   3. Channel Width: Selected for applicable load criteria.
   4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. 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.
   2. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   3. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
   4. Toggle Bolts: Stainless steel springhead type.
   5. Hanger Rods: Threaded steel.

2.03 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 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA NEIS 101
   2. NECA NEIS 102.
   3. NECA NEIS 105.
   4. NECA NEIS 111.

B. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceway and Boxes 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 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.

F. Secure raceways and cables to these supports with two-bolt conduit clamps.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 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 IMC and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
   6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
   1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.
   3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 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.
   2. Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting" and Section 09 96 00 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 26 05 29

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SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Type EMT-A and Type EMT-SS raceways and elbows.
2. Type EMT-S raceways and elbows.
3. Type ERMC-A and Type ERMC-SS raceways, elbows, couplings, and nipples.
4. Type ERMC-S raceways, elbows, couplings, and nipples.
5. Type IMC raceways.
6. Type LFMC raceways.
7. Type LFNC raceways.
8. Type PVC raceways and fittings.
9. Fittings for conduit, tubing, and cable.
10. Threaded metal joint compound.
11. Solvent cements.
12. Strut-type channel raceways and fittings.
13. Wireways and auxiliary gutters.
14. Metallic outlet boxes, device boxes, rings, and covers.
15. Termination boxes.
16. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.
17. Cover plates for device boxes.

B. Related Requirements:
1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 05 19 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).
3. Section 27 05 28 "Pathways for Communications Systems" for conduits, wireways, surface pathways, inner duct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:
1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Surface nonmetallic raceways.
4. Floor boxes.
5. Cabinets, cutout boxes, and miscellaneous enclosures.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details. Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness at location where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

1.03 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions:
1. For Type ERMC-S-PVC.

PART 2 PRODUCTS

2.01 TYPE EMT-A AND TYPE EMT-SS RACEWAYS AND ELBOWS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797A and UL Category Control Number FJMX.

B. Aluminum Electrical Metal Tubing (EMT-A) and Elbows:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Conduit; Norsk Hydro ASA, Hydro Extrusion USA LLC.
      b. Patriot Aluminum Products, LLC.
   2. Material: Aluminum.
   3. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.

C. Stainless Steel Electrical Metal Tubing (EMT-SS) and Elbows:
   1. Material: Stainless steel.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.

2.02 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:
   1. Material: Steel.
   2. Options:
      a. Exterior Coating: Zinc.
      b. Interior Coating: Zinc.
      c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      d. Colors: As indicated on Drawings.

2.03 TYPE ERMC-A AND TYPE ERMC-SS RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 6A and UL Category Control Number DYWV.

B. Aluminum Electrical Rigid Metal Conduit (ERMC-A), Elbows, Couplings, and Nipples:
   1. Material: Aluminum.
   2. Options:
      a. Protective Coating: Provide protective coating for use in concrete direct burial use in severely corrosive environment.
      b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      c. Colors: As indicated on Drawings.

C. Stainless Steel Electrical Rigid Metal Conduit (ERMC-SS), Elbows, Couplings, and Nipples:
   1. Material: Stainless steel.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.

2.04 TYPE ERMC-S RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:
   1. Exterior Coating: Zinc.
   2. Options:
      a. Interior Coating: Zinc.
      b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

c. Colors: As indicated on Drawings.

C. PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
1. Additional Characteristics:
a. Fittings for PVC-Coated Conduit:
1) Minimum coating thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
2) Conduit bodies must be Form 8 with an effective seal and a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.
3) Form 2-inch-long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
4) PVC coating on the outside of conduit couplings must be protected from tool damage during installation.
5) Female threads on fittings and couplings must be protected by urethane coating.
6) Fittings must be from same manufacturer as conduit.
7) Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover the exposed portions of threads.
2. Options:
a. Exterior Coating: PVC complying with NEMA RN 1.
b. Interior Coating: Zinc.
c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
d. Colors: As indicated on Drawings.
e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
f. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.05 TYPE IMC RACEWAYS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

B. Steel Electrical Intermediate Metal Conduit (IMC):
1. Options:
a. Exterior Coating: Zinc.
b. Interior Coating: Zinc.
c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
d. Colors: As indicated on Drawings.

2.06 TYPE LFMC RACEWAYS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):
1. Material: Steel.
2. Options:
a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Colors: As indicated on Drawings.

C. Stainless Steel Liquidtight Flexible Metal Conduit (LFMC-SS):
1. Material: Stainless steel.
2. Options:
a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Colors: As indicated on Drawings.

2.07 TYPE LFNC RACEWAYS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 1660 and UL Category Control Number DXOQ.

B. Layered (Type A) Liquidtight Flexible Nonmetallic Conduit (LFNC-A):
   1. Additional Criteria: Type A conduit with smooth seamless inner core and cover bonded together with one or more reinforcement layers between core and cover.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.
      c. Markings: 105 deg C dry Sunlight resistant Outdoor Direct burial.

C. Integral (Type B) Liquidtight Flexible Nonmetallic Conduit (LFNC-B):
   1. Additional Criteria: Type B conduit with smooth inner surface with integral reinforcement within conduit wall.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.
      c. Markings: 105 deg C dry Sunlight resistant Outdoor Direct burial.

D. Corrugated (Type C) Liquidtight Flexible Nonmetallic Conduit (LFNC-C):
   1. Additional Criteria: Type C conduit with corrugated internal and external surfaces without integral reinforcement within conduit wall.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Colors: As indicated on Drawings.
      c. Markings: 105 deg C dry Sunlight resistant Outdoor Direct burial.

2.08 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
   1. Dimensional Specifications: Schedule 40.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Markings: For use with maximum 90 deg C wire. For directional boring applications.

C. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:
   1. Dimensional Specifications: Schedule 80.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
      b. Markings: For use with maximum 90 deg C wire. For directional boring applications.

D. Type A Rigid PVC Concrete-Encased Conduit (PVC-A) and Fittings:
   1. Dimensional Specifications: Type A.
   2. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

E. Type EB Rigid PVC Concrete-Encased Underground Conduit (PVC-EB) and Fittings:
   1. Dimensional Specifications: Type EB.
   2. Options:
      a. Minimum Trade Size: Metric designator 53 (trade size 2).

2.09 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type ERMC, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:
   1. General Characteristics: UL 514B and UL Category Control Number DWTT.
   2. Options:
      a. Material: Die cast.
      b. Coupling Method: Compression coupling.
      c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
      d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:
   1. General Characteristics: UL 514B and UL Category Control Number FKAV.
   2. Options:
      a. Material: Die cast.
      b. Coupling Method: Compression coupling.
      c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
      d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

D. Fittings for Type FMC Raceways:
   1. General Characteristics: UL 514B and UL Category Control Number ILNR.

E. Fittings for Type LFMC and Type LFNC Raceways:
   1. General Characteristics: UL 514B and UL Category Control Number DXAS.

2.10 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

2.11 SOLVENT CEMENTS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.

B. Solvent Cements for Type PVC Raceways and Fittings:

2.12 STRUT-TYPE CHANNEL RACEWAYS AND FITTINGS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 5B and UL Category Control Number RIUU.

B. Strut-Type Channel Raceways and Fittings with Metallic Covers:
   1. Options:
      a. Manufacturer's standard enamel finish in color selected by Architect.

2.13 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:
   1. Additional Characteristics:
      a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
      b. Finish: Manufacturer's standard enamel finish.
   2. Options:
      a. Degree of Protection: Type 3R unless otherwise indicated.

b. Wireway Covers: Hinged type Screw-cover type unless otherwise indicated.

2.14 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:
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: Cast metal.
b. Sheet Metal Depth: Minimum 2.5 inch.
c. Cast-Metal Depth: Minimum 2.4 inch.
d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing more than 50 lb and marked with maximum allowable weight.
e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb.

C. 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.

D. Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:
a. Material: Cast metal.
b. Sheet Metal Depth: minimum 2.5 inch.
c. Cast-Metal Depth: minimum 2.4 inch.

E. Metallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

F. 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.

G. 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.

H. Metallic Concrete Boxes and Covers:
2. Description: Box intended for use in poured concrete.

2.15 TERMINATION BOXES

A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.

B. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1773 and UL Category Control Number XCKT.

C. Termination Boxes and Termination Bases for Installation on-line Side of Service Equipment:
1. Additional Characteristics: Listed and labeled for installation on-line side of service equipment.

D. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:
1. Additional Characteristics: Listed and labeled for installation on load side of service equipment.

2.16 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics:
      a. Non-Environmental Characteristics: UL 50.
      b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:
   1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
   2. Additional Characteristics: UL Category Control Number CYIV.
   3. Options:
      a. Degree of Protection: Type 1.

C. Indoor Sheet Metal Cutout Boxes:
   1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
   2. Additional Characteristics: UL Category Control Number CYIV.
   3. Options:
      a. Degree of Protection: Type 1.

D. Indoor Sheet Metal Junction and Pull Boxes:
   1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
   2. Additional Characteristics: UL Category Control Number BGUZ.
   3. Options:
      a. Degree of Protection: Type 1.

E. Indoor Sheet Metal Miscellaneous Enclosures:
   1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
   2. Options:
      a. Degree of Protection: Type 1.

F. Outdoor Sheet Metal Cabinets:
   1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.
   2. Additional Characteristics: UL Category Control Number CYIV.
   3. Options:
      a. Degree of Protection: Type 3R.

G. Outdoor Sheet Metal Cutout Boxes:
   1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.
   2. Additional Characteristics: UL Category Control Number CYIV.
   3. Options:
      a. Degree of Protection: Type 3R.

H. 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. Additional Characteristics: UL Category Control Number BGUZ.
   3. Options:
      a. Degree of Protection: Type 3R.

I. Outdoor Sheet Metal Miscellaneous Enclosures:
   1. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
   2. Options:
      a. Degree of Protection: Type 3R.

2.17 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. General Characteristics:
      a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
      b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:
   1. Options:
      a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
      b. Wallplate Material: 0.032-inch-thick Type 302/304 non-magnetic stainless steel with brushed finish.

PART 3 EXECUTION

3.01 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of 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: ERMC.
   4. Concealed Aboveground: EMT.
   5. Direct Buried: PVC-80.
   6. Concrete Encased in Trench: PVC-40.
   7. 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. Subject to severe physical damage includes the following locations:
      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. Subject to physical damage includes the following locations:
      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.
   7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
   1. ERMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.02 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written 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 6P.
   h. Locations Exposed to Prolonged Submersion: Type 6P.
   i. Locations Exposed to Corrosive Agents: Type 4X.
   j. Locations Exposed to Spraying Oil or Coolants: Type 13.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
   1. Boxes with knockouts or unprotected openings are prohibited.
   2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.03 INSTALLATION OF RACEWAYS

A. Installation Standards:
   1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
   2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
   3. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
   4. Comply with NECA NEIS 101 for installation of steel raceways.
   5. Comply with NECA NEIS 102 for installation of aluminum raceways.
   6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
   7. Install 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.
   8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
   9. Raceway Terminations at Locations Subject to Moisture or Vibration:
      a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

B. General Requirements for Installation of Raceways:
   1. Complete raceway installation before starting conductor installation.
   2. 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 above finished floor.
   3. 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 of changes in direction.
   4. Make bends in 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.

5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inches of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
   a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   b. Where an underground service raceway enters a building or structure.
   c. Conduit extending from interior to exterior of building.
   d. Conduit extending into pressurized duct and equipment.
   e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
   f. Where otherwise required by NFPA 70.
9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inches of the bottom side of a metal deck roof.
11. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. 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.
13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inches of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Requirements for Installation of Specific Raceway Types:
   1. Types EMT-A, ERMC-A, and FMC-A:
      a. Do not install aluminum raceways or fittings in contact with concrete or earth.
   2. 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 raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
   3. Type ERMC-S-PVC:
      a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
      b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC raceway.
      c. Coat field-cut threads on PVC-coated raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
   4. Types FMC, LFMC, and LFNC:
   5. Comply with NEMA RV 3. 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 and EPEC:
      a. Do not install Type PVC or Type EPEC conduit where ambient temperature exceeds 122 deg F. 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 written instructions for solvent welding and fittings.
   7. Type RTRC:
      a. Do not install Type RTRC conduit where ambient temperature exceeds 230 deg F.

D. Raceways Embedded in Slabs:
   1. Run raceways larger than metric designator 27 (trade size 1) parallel or at right angles to main reinforcement. Were at right angles to reinforcement, place raceway close to slab support. Secure raceways to reinforcement at maximum 10 ft intervals.
   2. Arrange raceways to cross building expansion joints with expansion fittings at right angles to the joint.
   3. Arrange raceways to ensure that each is surrounded by a minimum of 2 inch of concrete without voids.
   4. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
   5. Change from ENT to ERMC before rising above floor.

E. Stub-ups to Above Recessed Ceilings:
   1. Provide EMT, IMC, or ERMC for raceways.
   2. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

F. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
   1. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   2. EMT: Provide compression, cast-metal fittings. Comply with NEMA FB 2.10.
   3. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

G. Expansion-Joint Fittings:
   1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
   2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
      a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
      b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
      c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
      d. Attics: 135 deg F temperature change.
   3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
   4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
   5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

H. Raceways Penetrating Rooms or Walls with Acoustical Requirements:
   1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.04 INSTALLATION OF SURFACE RACEWAYS

A. Install surface raceways only were indicated on Drawings.

B. Install surface raceway with a minimum 2-inch radius control at bend points.

C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.05 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. 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.

C. 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.

D. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

G. 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.

H. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

I. Set metal floor boxes level and flush with finished floor surface.

J. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

K. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

L. 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.

M. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
   1. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
   2. Provide gaskets for wallplates and covers.

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.07 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.

3.08 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

END OF SECTION 26 05 33

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

B. Related Requirements:
1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 ROUND SLEEVES

A. Wall Sleeves, Steel:
1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Pipe Sleeves, PVC:
1. Description: ASTM D1785, Schedule 40.

C. Sheet Metal Sleeves, Galvanized Steel, Round:
1. Description: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.02 RECTANGULAR SLEEVES

2.03 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 GROUT

A. Description: 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, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.05 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 EXECUTION

3.01 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 07 92 00 "Joint Sealants."
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless sleeve seal 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 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 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 annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.02 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.03 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 26 05 44

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Labels.
   2. Bands and tubes.
   3. Tapes and stencils.
   4. Tags.
   5. Signs.
   6. Cable ties.
   7. Miscellaneous identification products.

B. Related Requirements:
   1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 ACTION SUBMITTALS

A. Product Data:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

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 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 and Section 26 05 73.19 "Arc-Flash Hazard Analysis" 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.

2.02 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 service feeder and branch-circuit conductors.

C. Color must be factory applied.
   1. Colors for 208Y/120 V Circuits:
      a. Phase A: Black.

b. Phase B: Red.
c. Phase C: Blue.

2. Colors for 240 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.

3. Colors for 480Y/277 V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Color for Neutral: White.
5. Color for Equipment Grounds: Green.
6. Colors for Isolated Grounds: Green with two or more yellow stripes.

D. Raceways and Cables Carrying Circuits at More Than 1000 V:
   1. Black letters on orange field.
   2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

E. Warning Label Colors:
   1. Identify system voltage with black letters on orange background.

F. 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."

G. Equipment Identification Labels:
   1. Black letters on white field.

2.03 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

B. Manufacturers: Subject to compliance with requirements,
   1. Provide products by one of the following:
      a. Brady Corporation.
      b. emedco.
      c. Marking Services, Inc.
      d. Panduit Corp.

   2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
   3. Marker for Labels:
      a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
      b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.04 BANDS AND TUBES

A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Panduit Corp.

2.05 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Marking Services, Inc.
      b. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. emedco.
      c. Marking Services, Inc.

C. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
      b. Printing on tape must be permanent and may not be damaged by burial operations.
      c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   2. Color and Printing:
      a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
      b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW”.
      c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW”.
   3. Tape Type ID:
      a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, compounded for direct-burial service.
      b. Width: 3 inches.
      c. Overall Thickness: 5 mil.
      d. Foil Core Thickness: 0.35 mil.
      e. Weight: 28 lb/1000 sq. ft.
      f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.06 TAGS

A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. emedco.
      c. Marking Services, Inc.
      d. Panduit Corp.

2.07 SIGNS

A. Baked-Enamel Signs:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. emedco.
      b. Marking Services, Inc.
   2. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
   3. 1/4-inch grommets in corners for mounting.
   4. Nominal Size: 7 by 10 inch.

2.08 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
   3. Temperature Range: Minus 40 to plus 185 deg F.
   4. Color: Black.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   1. Minimum Width: 3/16 inch.
   2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.

3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.09 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

3.01 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.

3.02 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.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. 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."

M. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

O. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

P. 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 where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

R. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

S. Nonmetallic Preprinted Tags:
   1. Place in location with high visibility and accessibility.
   2. Secure using UV-stabilized plenum-rated cable ties.

T. 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-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inch high.

U. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.03 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 Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

D. 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."

E. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels self-adhesive vinyl tape to identify phase.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use with conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with conductor designation.

H. Conductors to Be Extended in Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Marker tape Self-adhesive vinyl 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.

J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

K. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Emergency Operating Instruction Signs: Baked-enamel warning signs with white legend on red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

O. Equipment Identification Labels:
   1. Indoor Equipment: Baked-enamel signs.
   2. Outdoor Equipment: Stenciled legend 4 inch high.
   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. Switchboards.
      e. Emergency system boxes and enclosures.
      f. Enclosed switches.
      g. Enclosed circuit breakers.
      h. Enclosed controllers.
      i. Variable-speed controllers.
      j. Power-transfer equipment.
      k. Contactors.
      l. Remote-controlled switches, dimmer modules, and control devices.
      m. Power-generating units.
      n. Monitoring and control equipment.

END OF SECTION 26 05 53

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Electronic time switches.
   2. Outdoor photoelectric switches, solid state, flexible mounting.
   3. Outdoor photoelectric switches, solid state, luminaire mounted.
   4. Outdoor photoelectric switches, low voltage.
   5. Indoor occupancy and vacancy sensors.
   6. Switchbox-mounted occupancy sensors.
   7. Digital timer light switch.
   8. Conductors and cables.

B. Related Requirements:
   1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 26 27 26 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.02 ACTION SUBMITTALS

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

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.

1.03 INFORMATIONAL SUBMITTALS

1.04 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.

B. Failures include, but are not limited to, the following:
   1. Faulty operation of lighting control software.
   2. Faulty operation of lighting control devices.

C. Extended Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ELECTRONIC TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Industries, Inc.
   2. Intermatic, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. NSi Industries LLC.
   5. Touché Lighting Control.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
   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. Contact Rating: 30 A inductive or resistive, 240 V(ac) 20 A ballast load, 120/240 V(ac).

3. Programs:
   a. Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
5. Astronomic Time: Selected channels.
6. Automatic daylight savings time changeover.
7. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, 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, 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.

2.03 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:
   1. Wall Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
   2. Passive infrared Ultrasonic Dual technology.
   3. Integrated Separate power pack.
   4. Hardwired Wireless connection to switch, and BAS and lighting control system.
   5. 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.
   6. 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.
      b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time, delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
      c. Combination Sensor: Unless otherwise indicated, sensor must be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time, delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
   8. Power: Line voltage.
   9. Power Pack: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
   10. Mounting:
   11. Sensor: Suitable for mounting in any position in a standard device box or outlet box.
   12. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   13. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
   14. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
   15. Bypass Switch: Override the "on" function in case of sensor failure.
   16. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

B. PIR Type: Wall Ceiling mounted; detect occupants in coverage area by their heat and movement.
   1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch.
   2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
   3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 ft. when mounted on a 10 ft. 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. when mounted 48 inch above finished floor.

C. Ultrasonic Type: Wall Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
   1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
   2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
   4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
   5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 ft. when mounted on a 10 ft. high ceiling in a corridor not wider than 14 ft.
   6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. 2000 sq. ft. when mounted 84 inch above finished floor.

D. Dual-Technology Type: Wall Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
   1. Sensitivity Adjustment: Separate for each sensing technology.
   2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch, and detect a person of average size and weight moving not less than 12 inch in either a horizontal or a vertical manner at an approximate speed of 12 inch/s.
   3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
   4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 sq. ft. 2000 sq. ft. when mounted 48 inch above finished floor.

2.04 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 using hardwired connection.
   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.
   4. Switch Rating: Not less than 800 VA LED load at 120 V, 1200 VA LED load at 277 V, and 800 W incandescent.

2.05 DIGITAL TIMER LIGHT SWITCH

A. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10-minute increments.
   1. Rated 960 W at 120 V(ac) for tungsten lighting, 10 A at 120 V(ac) or 10 A at 277 V(ac) for fluorescent or LED lighting, and 1/4 hp at 120 V(ac).
   2. Standards: Comply with UL 20.

3. Integral relay for connection to BAS.
4. Voltage: Match the circuit voltage.
5. Color: Per Architect.
6. Faceplate: Color matched to switch.

2.06 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 26 05 19 "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 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

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.

3.05 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 26 05 53 "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.

3.06 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Architect.

B. 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.

C. 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.

D. Prepare test and inspection reports.

E. Manufacturer Services:
   1. Engage factory-authorized service representative to supervise field tests and inspections.

3.07 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.
   2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
   3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

END OF SECTION 26 09 23

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SECTION 26 09 43.23

RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
1. Lighting control relay panels.
2. Networked lighting control panels.
3. Manual switches and cover plates.
4. Field-mounted signal sources.
5. Conductors and cables.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 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.

1.03 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.
9. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified.
    a. Show interconnecting signal and control wiring, and interface devices that show compatibility of inputs and outputs.

    b. For control interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

C. Field Quality-Control Submittals:
   1. Field quality-control reports.

1.04 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.05 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. Lighting Control Relays: Equal to 10 percent of amount installed for each size indicated, but no fewer than 4.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation in accordance with NECA 407.

1.07 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: Four 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

2.01 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.

2.02 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 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac).
2. 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.

2.03 NETWORKED LIGHTING CONTROL PANELS

A. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels must be capable of being interconnected with digital communications to appear to the operator as a single lighting control system.

B. Lighting Control Panels:
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. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit must provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
2. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
b. Panel summary showing the master and slave panels connected to the controller.
c. Controller diagnostic information.
d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens must also allow direct breaker control and zone overrides.
3. 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. 16 special date periods.

4. Time Synchronization: The timing unit must be updated not less than every hour(s) with the network time server.
5. 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 "blinking warning" must warn occupants approximately five minutes before actuating the off sequence.
   e. Activity log, storing previous relay operation, including the time and cause of the change of status.
   f. Download firmware to the latest version offered by manufacturer.

D. Standard Control Unit, Installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916.
1. Electronic control for operating and monitoring individual relays, and display relay on-time.
2. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation.
3. Integral keypad and digital-display front panel for local setup, including the following:
   a. Blink notice, time adjustable from software.
   b. Ability to log and display relay on-time.
   c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.

E. Relays:
1. Electrically operated, mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 5 kA. Control must be three-wire, 24 V(ac) or digital control network.
2. 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) or digital control network.

F. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 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 control-voltage photo sensors.

G. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device must remain the property of Owner.

H. Software:
1. Menu-driven data entry.
2. Online and offline programming and editing.
3. Provide for entry of the room or space designation for the load side of each relay.
4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
5. Size the software appropriate to the system.

2.04 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.

2.05 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: 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.

2.06 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 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Twisted-Pair Data Cable: Category 6.
   1. Comply with requirements for twisted pair cabling in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.01 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.

3.02 INSTALLATION OF WIRING

A. Wiring Methods:
   1. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters.
   2. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, accessible ceiling spaces, and gypsum board partitions where unenclosed wiring method may be used.
   3. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
   4. Conceal raceway and cables except in unfinished spaces.
   5. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
   6. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
   7. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes 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.

3.03 INSTALLATION OF PANELS

A. Install panels and accessories in accordance with NECA 407.

B. Mount top of trim 90 inch above finished floor unless otherwise indicated.

C. Mount panel cabinet plumb and rigid without distortion of box.

D. Install filler plates in unused spaces.

3.04 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."

3.05 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Architect.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers described below and low-voltage surge arrestors. 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 adjustments for final protective device settings in accordance with the overcurrent protective device coordination study. Comply with requirements in Section 260573.16 "Coordination Studies."
        9) 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.
        10) Perform a contact/pole-resistance test.
        11) 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.
        12) Determine long-time pickup and delay by primary current injection.
        13) Determine short-time pickup and delay by primary current injection.
        14) Determine ground-fault pickup and time delay by primary current injection.
        15) Determine instantaneous pickup by primary current injection.
        16) Test functions of the trip unit by means of secondary injection.
        17) Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
        18) 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.
        19) Verify operation of charging mechanism.
    b. Surge Arrestor Tests:
        1) Compare nameplate with the Contract Documents.
        2) Inspect physical and mechanical conditions.
        3) Inspect anchorage, alignment, grounding, and clearances.
        4) Verify that the units are clean.
        5) Inspect bolted electrical connections for high resistance using one or more of the following methods:
            a) Low-resistance ohmmeter.
            b) Verify tightness of bolted electrical connections by calibrated torque wrench.

6) Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
7) Perform an insulation-resistance test on each arrestor, phase terminal-to-ground using voltage in accordance with manufacturer instructions.
8) Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding tests.

C. 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.

D. 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.

E. Manufacturer Services:
1. Engage factory-authorized service representative to support field tests and inspections.

3.06 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.

3.07 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.

3.08 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 26 09 43.23

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SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01SUMMARY

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

1.02 SUMMARY

A. Section Includes:
1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.
1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.09 FIELD CONDITIONS

A. Environmental Limitations:
   1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
      b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Architect Owner no fewer than seven days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Architect's Owner's written permission.
   3. Comply with NFPA 70E.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
   1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
   1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
      b. Outdoor Locations: NEMA 250, Type 3R.
      c. Kitchen Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
      d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
5. Finishes:
   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.

F. Incoming Mains:
1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 20 percent.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.03 POWER PANELBOARDS

A. Panelboards: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

F. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or lugs only.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.
   1. Doors: Concealed hinges secured with multipoint latch with tumbler lock; keyed alike.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers:
      a. Inverse time-current element for low-level overloads.
      b. Instantaneous magnetic trip element for short circuits.
      c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Electronic Trip Circuit Breakers:
      a. RMS sensing.
      b. Field-replaceable rating plug or electronic trip.
      c. Digital display of settings, trip targets, and indicated metering displays.
      d. Multi-button keypad to access programmable functions and monitored data.
      e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
      f. Integral test jack for connection to portable test set or laptop computer.
      g. Field-Adjustable Settings:
         1)Instantaneous trip.
         2)Long- and short-time pickup levels.
         3)Long- and short-time adjustments.
         4)Ground-fault pickup level, time delay, and I squared T response.
   3. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Ground-Fault Protection: relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   g. Shunt Trip: Coordinate shunt voltage for trip coil energized from separate circuit, set to trip at recommended percent of rated voltage.
   h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
   i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have electronic adjustable trip units.
   j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

2.06 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
   1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim 90 inches above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
1. Install overcurrent protective devices and controllers not already factory installed.
2. Set field-adjustable, circuit-breaker trip ranges.
3. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

K. Install filler plates in unused spaces.

L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

N. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 05 53 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Perform optional tests. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      i. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

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SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
1. General-use switches, dimmer switches, and fan-speed controller switches.
2. General-grade single straight-blade receptacles.
3. General-grade duplex straight-blade receptacles.
4. Receptacles with arc-fault and ground-fault protective devices.
5. Locking receptacles.
6. Connectors, cords, and plugs.

B. Related Requirements:
1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 26 09 23 "Lighting Control Devices" for occupancy sensors, timers, control-voltage switches, and control-voltage dimmers.

1.02 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.

1.03 ACTION SUBMITTALS

A. Product Data:
1. Toggle switches.
2. Maintained-contact switches.
3. Momentary-contact switches.
4. Rocker switches.
5. Dimmer switches.
6. Single straight-blade receptacles
7. Duplex straight-blade receptacles.
8. Receptacles with GFCI device.

B. Shop Drawings:
1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Provide samples as requested by the Owner or Architect:
1. One for each kind of toggle switch and cover plate accessory specified, in each finish and color specified.
2. One for each kind of duplex straight-blade receptacle and cover plate accessory specified, in each finish and color specified.
3. One for each kind of receptacle with GFCI device and cover plate accessory specified, in each finish and color specified.

D. Field Quality-Control Submittals:
1. Field quality-control reports.

1.04 INFORMATIONAL SUBMITTALS

A. Manufacturers' Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
1. Dimmers.
2. Duplex straight-blade receptacles.
3. Receptacles with GFCI device.

B. Sample warranties.

1.05 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.

1.06 WARRANTY FOR DEVICES

B. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
   1. Extended Warranty Period: Three years from date of Substantial Completion; prorated coverage for labor, materials, and equipment.
   2. Follow-On Extended Warranty Period: Eight years from date of Substantial Completion; full coverage for materials only, free on-board destination, freight prepaid.

PART 2 PRODUCTS

2.01 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) General-duty, 120-277 V, 20 A, single pole three-way four way.
         2) Extra-heavy-duty, 120-277 V, 20 A, single pole double pole.
         3) Extra-heavy-duty, 120-277 V, 30 A, single pole double pole.
   4. Accessories:
      a. Cover Plate: 0.060 inch 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. Rocker 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)120-277 V, 20 A, single pole double pole three-way four way.
   4. Accessories:
      a. Cover Plate: 0.060 inch 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. 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: Rocker.
      c. Dimming Control Style: Slide.
   4. Accessories:

a. Cover Plate: 0.060 inch 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.

2.02 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) General-duty, NEMA 5-15R NEMA 5-20R.
4. Accessories:
a. Cover Plate: 0.060 inch thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. Tamper-Resistant Duplex Straight-Blade Receptacle:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
2. General Characteristics:
a. Reference Standards: UL CCN RTRT and UL 498.
3. Options:
a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) General-duty, NEMA 5-15R.
2) Heavy-duty, NEMA 5-20R.
4. Accessories:
a. Cover Plate: 0.060 inch 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.

2.03 RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT PROTECTIVE DEVICES

A. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI 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 AWBZ, UL 498, UL 1699, and UL Subject 1699A.
3. Options:
a. Device Color: As indicated on architectural Drawings.
b. Configuration: Heavy-duty, NEMA 5-15R NEMA 5-20R.
4. Accessories:
a. Cover Plate: 0.060 inch 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. General-Grade, Tamper-Resistant Duplex Straight-Blade Receptacle with AFCI and 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 KCXX, UL 498, UL 943, UL 1699, and UL Subject 1699A.
3. Options:
a. Device Color: As indicated on architectural Drawings.

b. Configuration: Heavy-duty, NEMA 5-15R NEMA 5-20R.

4. Accessories:
   a. Cover Plate: 0.060 inch 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

3.01 EXAMINATION

A. Receptacles:
   1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.02 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 26 05 53 "Identification for Electrical Systems."
      a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white -filled lettering, and provide durable wire markers or tags inside device box or outlet box.
      b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

D. Interfaces with Other Work:
   1. Coordinate installation of new products with existing conditions.

3.03 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. Hospital-Grade Receptacle Orientation: Orient receptacle with ground pin or neutral pin at top.
   5. 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 26 05 53 "Identification for Electrical Systems."
      a. Mark cover or cover plate using hot, stamped, or engraved machine printing with white -filled lettering, and provide durable wire markers or tags inside device box or outlet box.
      b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

D. Interfaces with Other Work:
   1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.
   2. Coordinate installation of new products with existing conditions.

3.04 FIELD QUALITY CONTROL OF SWITCHES

A. Testing Preparation:

B. Field tests and inspections must be witnessed by Architect.

C. Tests and Inspections:
   1. Perform tests and inspections in accordance with manufacturers' instructions.

D. Nonconforming Work:
   1. Unit will be considered defective if it does not pass tests and inspections.
   2. Remove and replace defective units and retest.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.05 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Testing Preparation:

B. Field tests and inspections must be witnessed by Architect.

C. 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. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
   7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

D. Nonconforming Work:
   1. Device will be considered defective if it does not pass tests and inspections.
   2. Remove and replace defective units and retest.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.06 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.

B. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly and lubricate as recommended in writing by manufacturer.

3.07 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.

B. Cord Reels and Fittings:
   1. After installation, protect cord reels and fittings 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.

C. Connectors, Cords, and Plugs:
   1. After installation, protect connectors, cords, and plugs 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 26 27 26

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Control circuits.
      b. Motor-control centers.
      c. Panelboards.
      d. Switchboards.
      e. Enclosed controllers.
      f. Enclosed switches.
   2. Spare-fuse cabinets.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   3. Current-limitation curves for fuses with current-limiting characteristics.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures, "Section 017823 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.
   3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
   4. Coordination charts and tables and related data.

1.05 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.

1.06 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C) ,apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
   1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
   3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
   4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, 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.
   7. Type T: 250-V, zero- to 1200-A, 600-V, zero- to 800-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.

2.03 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
   1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
   2. Finish: Gray, baked enamel.
   3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
   4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 EXECUTION

3.01 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.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Service Entrance: Class L, fast acting or Class RK1, time delay.
   2. Feeders: Class L, fast acting or Class RK1, time delay.
   3. Motor Branch Circuits: Class RK1, time delay.
   4. Large Motor Branch (601-4000 A): Class L, time delay.
   5. Power Electronics Circuits: Class T, fast acting.
   6. Other Branch Circuits: Class RK1, time delay.
   7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
   8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.04 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 26 28 13

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Receptacle switches.
   4. Shunt trip switches.
   5. Molded-case circuit breakers (MCCBs).
   6. Molded-case switches.
   7. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   2. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   3. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.07 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.
2. Fuse Pullers: Two for each size and type.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.09 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.02 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:
   1. Single throw.
   2. 1200 A and smaller.
   3. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
   4. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

B. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Lugs: Mechanical type, suitable for number, size, and conductor material. Provide lug kits as required to accommodate specified conductor size.
   6. Service-Rated Switches: Labeled for use as service equipment.

2.03 SHUNT TRIP SWITCHES

A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.

B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.

D. Accessories:
   1. Oiltight key switch for key-to-test function.
   2. Oiltight green ON pilot light.
   3. Isolated neutral lug; 200 percent rating.
   4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
   5. Form C alarm contacts that change state when switch is tripped.
   6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
   7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
   8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   11. Lugs: Mechanical type, suitable for number, size, and conductor material.
   12. Service-Rated Switches: Labeled for use as service equipment.

2.04 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated as indicated on the Drawings.

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. Electronic Trip Circuit Breakers: Any circuit breaker rated 400 A and larger. Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
   1. Instantaneous trip.
   2. Long- and short-time pickup levels.
   3. Long- and short-time time adjustments.
   4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

N. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contact's mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Electrical Operator: Provide remote control for on, off, and reset operations.

2.05 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

C. Operating Mechanism: The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

E. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's written permission.
4. Comply with NFPA 70E.

3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel unless otherwise noted.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.04 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.05 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the two following methods:
         1) Use a low-resistance ohmmeter.
            (a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            (b) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
      b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data

are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.
1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.07 ADJUSTING

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as required.

END OF SECTION 26 28 16

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

B. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.

1.02 SUMMARY

A. Section Includes:
   1. Type 1 surge protective devices
   2. Enclosures
   3. Conductors and cables

1.03 DEFINITIONS

A. In: Nominal discharge current

B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.

C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.

D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).

E. SCCR: Short-circuit current rating.

F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

G. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection

1.04 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Include electrical characteristics, specialties, and accessories for SPDs.
      b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:
         1) Tested Values for VPRs
         2) In ratings.
         3) MCOV, type designations.
         4) OCPD requirements.
         5) Manufacturer’s model number.
         6) System voltage.
         7) Modes of protection

B. Field quality-control reports.

1.05 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.06 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.
   1. Initial Extended Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 PRODUCTS

2.01 TYPE 1 SURGE PROTECTION DEVICES (SPDS)

A. Source Limitations: Obtain devices from single source from single manufacturer.

B. General Characteristics:
   1. Reference Standards: UL 1449, Type 1.
   2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems.
   3. Peak Surge Current Rating: 240 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode
   4. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
      a. Line to Neutral: 700 V.
      b. Line to Line: 1200 V.
   5. SCCR: Not less than 100 kA
   6. In rating: 20 kA

C. Options:
   1. Include integral disconnect switch.
   2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   3. Include indicator light display for protection status.
   4. Include audible alarm.
   5. Include surge counter.

2.02 ENCLOSURES

A. Outdoor enclosures: Type 4X.

2.03 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   1. Do not plice and extend SPD leads unless specifically permitted by manufacturer.
   2. Do not exceed manufacturer’s recommended lead length.
   3. Do not bond neutral and ground.

C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.02 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Architect.

B. Tests and Inspections
   1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

C. Nonconforming Work:
   1. SPDs that do not pass tests and inspections will be considered defective.
   2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

E. Manufacturer Service:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.03 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 26 43 13

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SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Interior Lighting Fixtures
   2. Materials.
   3. Luminaire support.

B. Related Requirements:
   1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.03 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.

1.04 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.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.
      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.
      b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:
   1. Product Data: Indicating luminaire is certified by ENERGY STAR Design Lights Consortium.

D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

E. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
   1. Include Samples of luminaires and accessories involving color and finish selection.

F. Samples for Verification: For each type of luminaire.
   1. Include Samples of luminaires and accessories to verify finish selection.

G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.05 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.
   2. Suspended ceiling components.
   3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
   4. Structural members to which equipment and luminaires will be attached.
   5. Initial access modules for acoustical tile, including size and locations.
   6. Items penetrating finished ceiling, including the following:
      a. Other luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Ceiling-mounted projectors.
   7. Moldings.

B. Sample warranty.

1.06 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.

1.07 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.

1.08 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.
   2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

E. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

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.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

B. Relative Humidity: Zero to 95 percent.

C. Altitude: Sea level to 1000 feet.

2.02 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.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.03 INTERIOR LIGHTING FIXTURES.

A. Lamp:
   1. Lumens as specified on drawings.
   2. Minimum allowable efficacy of 80 lm/W.
   3. CRI of minimum 80. CCT as specified.
   4. Rated lamp life of 50,000 hours to L70.
   5. Dimmable from 100 percent to zero percent of maximum light output.
   6. Internal driver.
   7. User-Replaceable Lamps:
      a. Bulb shape complying with ANSI C78.79.
      b. Lamp base complying with ANSI C81.61 or IEC 60061-1.
   8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

B. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear powder-coat finish.

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. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. With integral mounting provisions.

E. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.
   3. UL Listing: Listed for damp location.

2.04 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.

2.05 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.

2.06 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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 a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:
1. Ceiling Mount:
a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length.
c. Hook mount.
2. Pendants and Rods: Where longer than 48 inches, 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 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.04 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.05 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.

3.06 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 26 51 19

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SECTION 26 52 13
EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Emergency lighting.
   2. Exit signs.
   3. Materials.
   4. Luminaire support components.

B. Related Requirements:
   1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.02 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 lm = 1 cd-sr).

1.03 ACTION SUBMITALS

A. Shop Drawings:
   1. For nonstandard or custom luminaires.
      a. Include plans, elevations, sections, and mounting and attachment details.
      b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
      c. Include diagrams for power, signal, and control wiring.

B. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.

C. Product Schedule:
   1. For emergency lighting units. Use same designations indicated on Drawings.
   2. For exit signs. Use same designations indicated on Drawings.

1.04 INFORMATION 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 special warranty.

1.05 QUALITY ASSURANCE

1.06 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.

A. Special Manufacturer Extended Warranty for Batteries for Emergency and Exit Lighting: Manufacturer warrants that batteries for emergency luminaires and exit signs perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended warranty period.
   1. Extended Warranty Period: Five year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS FO 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. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
   1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
   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. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
   4. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   5. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   6. Battery: Sealed, maintenance-free, nickel-cadmium type.
   7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   8. 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.

2.02 EMERGENCY LIGHTING

A. General Characteristics: Self-contained units.

B. Emergency Lighting Unit:
   1. Wall with universal junction box adaptor.
   2. UV stable thermoplastic housing, rated for damp locations.
   3. Two LED lamp heads.
   4. Internal emergency power unit.

2.03 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. Lamps for AC Operation:
         1) LEDs; 50,000 hours minimum rated lamp life.
      b. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.04 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. Diffusers and Globes:
1. Clear, UV-stabilized acrylic.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
1. Extruded aluminum housing and heat sink.
2. powder coat finish.

E. Conduit: EMT, minimum metric designator 21 (trade size 3/4).

2.05 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.

2.06 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "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.

PART 3 EXECUTION

3.01 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.

3.02 INSTALLATION

A. Install luminaires level, plumb, and squire with ceilings and walls unless otherwise indicated.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.04 FIELD QUALITIY CONTROL

A. Field tests and inspections must be witnessed by Architect.

B. 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.

C. 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.

D. Prepare test and inspection reports.

3.05 SYSTEM STARTUP

A. Perform startup service:
1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.06 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
1. Inspect luminaires. Replace lamps, emergency power units, batteries, 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.

3.07 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 26 52 13

SECTION 28 46 21.11
ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Addressable fire-alarm system.
   2. Fire-alarm control unit (FACU).
   3. Manual fire-alarm boxes.
   4. System smoke detectors.
   5. Duct smoke detectors.
   6. Heat detectors.
   7. Fire-alarm notification appliances.
   8. Firefighters' two-way telephone communication service.
   9. Fire-alarm remote annunciators.
   10. Fire-alarm addressable interface devices.
   11. Digital alarm communicator transmitters (DACTs).
   12. Fire-alarm radio transmitters.

B. Related Requirements:

C. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.

D. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.03 DEFINITIONS

A. DACT: Digital alarm communicator transmitter.

B. EMT: Electrical metallic tubing.

C. FACU: Fire-alarm control unit.

D. 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.

E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).

F. NICET: National Institute for Certification in Engineering Technologies.

G. PC: Personal computer.

H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
   1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
   2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.04 ACTION SUBMITTALS

A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.

B. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.

2. Include rated capacities, operating characteristics, and electrical characteristics.

C. Shop Drawings: For fire-alarm system.
1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, and details, including details of attachments to other Work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Annunciator panel details as required by authorities having jurisdiction.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification-appliance circuits.
7. Include battery-size calculations.
8. Include input/output matrix.
9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
10. Include performance parameters and installation details for each detector.
11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors in accordance with manufacturer's written instructions.
    d. Show air-sampling detector pipe routing.
14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
15. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Qualification Statements: For Installer.

C. Sample Warranty: Submittal must include line-item pricing for replacement parts and labor.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
    a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
g. Record copy of site-specific software.
h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
   1) Equipment tested.
   2) Frequency of testing of installed components.
   3) Frequency of inspection of installed components.
   4) Requirements and recommendations related to results of maintenance.
   5) Manufacturer's user training manuals.
i. Manufacturer's required maintenance related to system warranty requirements.
j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On USB media.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
   3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
   4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
   5. Keys and Tools: One extra set for access to locked or tamper proofed components.
   6. Audible and Visual Notification Appliances: One of each type installed.
   7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.
   8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
   9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
   2. Installation must be by personnel certified by NICET as fire-alarm Level IV technician.
   3. Obtain certification by NRTL in accordance with NFPA 72.
   4. Licensed or certified by authorities having jurisdiction.

1.09 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 ADDRESSABLE FIRE-ALARM SYSTEM

A. Description:
   1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice-and-strobe notification for evacuation.

B. Performance Criteria:
   1. Regulatory Requirements:
      a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
   2. General Characteristics:
      a. Automatic sensitivity control of certain smoke detectors.
      b. Fire-alarm signal initiation must be by one or more of the following devices and systems:
         1) Manual stations.
         2) Heat detectors.
         3) Smoke detectors.
         4) Duct smoke detectors.
         5) Automatic sprinkler system water flow.
         6) Fire standpipe system.
         7) Fire pump running.
         8) Continuously operate alarm notification appliances, including voice evacuation notices.
         9) Identify alarm and specific initiating device at FACU and remote annunciators.
         10) Transmit alarm signal to remote alarm receiving station.
         11) Unlock electric door locks in designated egress paths.
         12) Release fire and smoke doors held open by magnetic door holders.
         13) Activate voice/alarm communication system.
         14) Switch HVAC equipment controls to fire-alarm mode.
         15) Activate smoke-control system (smoke management) at firefighters' smoke-control system panel.
         16) Activate stairwell and elevator-shaft pressurization systems.
         17) Close smoke dampers in air ducts of designated air-conditioning duct systems.
         18) Recall elevators to primary or alternate recall floors.
         19) Activate elevator power shunt trip.
         20) Activate emergency lighting control.
         21) Record events in system memory.
         22) Record events by system printer.
         23) Indicate device in alarm on graphic annunciator.
      c. Supervisory signal initiation must be by one or more of the following devices and actions:
         1) Valve supervisory switch.
         2) Elevator shunt-trip supervision.
         3) Fire pump is running.
         4) Fire pump has lost power.
         5) Power to fire pump has phase reversal.
         6) Zones or individual devices have been disabled.
         7) FACU has lost communication with network.
      d. System trouble signal initiation must be by one or more of the following devices and actions:
         1) Open circuits, shorts, and grounds in designated circuits.
         2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
         3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.

4) Loss of primary power at FACU.
5) Ground or single break in internal circuits of FACU.
6) Abnormal ac voltage at FACU.
7) Break in standby battery circuitry.
8) Failure of battery charging.
9) Abnormal position of switch at FACU or annunciator.
10) Voice signal amplifier failure.
11) Hose cabinet door open.

e. System Supervisory Signal Actions:
1) Initiate notification appliances.
2) Identify specific device initiating event at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
3) Record event on system printer.
4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
5) Transmit system status to building management system.
6) Display system status on graphic annunciator.

f. Network Communications:
1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
3) Provide integration gateway using BACnet or Modbus for connection to building automation system. Verify communication type with Building Automation System.

g. Document Storage Box:
1) Description: Enclosure to accommodate standard 8-1/2-by-11-inch (216-by-279 mm) manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
3) Color: Red powder-coat epoxy finish.
4) Labeling: Permanently screened with 1 inch (25 mm) high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
5) Security: Locked with 3/4-inch (19 mm) barrel lock. Provide solid 12 inch (304 mm) stainless steel piano hinge.

2.02 FIRE-ALARM CONTROL UNIT (FACU)

A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

B. Performance Criteria:
1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:
a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
b. Include real-time clock for time annotation of events on event recorder and printer.
c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
d. FACU must be listed for connection to central station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.

1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.

g. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
   1) Annunciator and Display: LCD, two lines of 80 characters.
   2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.

h. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
   1) Pathway Class Designations: NFPA 72, Class B.
   2) Pathway Survivability: Level 1.
   3) Install no more than 80% of addressable devices on each signaling-line circuit.
   4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.

i. Serial Interfaces:
   1) One dedicated RS 485 port for central-station operation using point ID DACT.
   2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
   3) One USB port for PC configuration.
   4) One RS 232 port for voice evacuation interface.

j. Smoke-Alarm Verification:
   1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
   2) Activate approved "alarm-verification" sequence at FACU and detector.
   3) Record events by system printer.
   4) Sound general alarm if alarm is verified.
   5) Cancel FACU indication and system reset if alarm is not verified.

k. Notification-Appliance Circuit:
   1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
   2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
   3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.

l. Elevator Recall: Initiate by one of the following alarm-initiating devices:
   1) Elevator lobby detectors except lobby detector on designated floor.
   2) Smoke detectors in elevator machine room.
   3) Smoke detectors in elevator hoistway.

m. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.

n. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
   1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.

o. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.

p. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

q. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in separate cabinet located adjacent to Fire Alarm Control Panel.

r. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
   1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
   2) Programmable tone and message sequence selection.
   3) Standard digitally recorded messages for "Evacuation" and "All Clear."
   4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
s. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
t. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
u. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
v. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and DACT must be powered by 24 V(dc) source.
w. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
x. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
y. Batteries: Sealed, valve-regulated, recombinant lead acid.

C. Accessories:
   1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.
   2. Preaction System Functionality:
      a. Initiate Presignal Alarm: This function must cause audible and visual alarm and indication to be provided at FACU. Activation of initiation device connected as part of preaction system must be annunciated at FACU only, without activation of general evacuation alarm.

2.03 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
   1. Single-action mechanism, plastic-rod pull-lever type; with integral addressable module a ranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
   2. Station Reset: Key- or wrench-operated switch.
   3. Able to perform at up to 90 percent relative humidity at 90 deg F.
   4. Material: Manual stations made of Lexan polycarbonate.
   5. Able to be used in indoor areas.

2.04 SYSTEM SMOKE DETECTORS

A. Photoelectric Smoke Detectors:
   1. Performance Criteria:
      a. Regulatory Requirements:
         1) NFPA 72.
         2) UL 268.
      b. General Characteristics:

1) Detectors must be two-wire type and UL-listed with panel.
2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
3) Base Mounting: Detector and associated electronic components must be mounted in ltwist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
   (a) Primary status.
   (b) Device type.
   (c) Present average value.
   (d) Present sensitivity selected.
   (e) Sensor range (normal, dirty, etc.).
8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
9) Color: White.
10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
11) Multiple levels of detection sensitivity for each sensor.
12) Sensitivity levels based on time of day.

2.05 DUCT SMOKE DETECTORS

A. Description: Photoelectric-type, duct-mounted smoke detector.

B. Performance Criteria:
   1. Regulatory Requirements:
      a. NFPA 72.
      b. UL 268A.
   2. General Characteristics:
      a. Detectors must be two-wire type.
      b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
      c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
      d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
      e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
      f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
         1) Primary status.
         2) Device type.
         3) Present average value.
         4) Present sensitivity selected.
         5) Sensor range (normal, dirty, etc.).
      g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
      h. Each sensor must have multiple levels of detection sensitivity.
      i. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

j. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.06 HEAT DETECTORS

A. Fixed-Temperature-Type Heat Detectors:
1. Performance Criteria:
a. Regulatory Requirements:
1) NFPA 72.
2) UL 521.
b. General Characteristics:
1) Actuated by temperature that exceeds fixed temperature of 190 deg F (88 deg C)
2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
4) Detector must have functional humidity range of 10 to 90 percent.
5) Color: White.

2.07 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Voice/Tone Notification Appliances:
1. Description: Notification appliances capable of outputting voice evacuation messages.
2. Performance Criteria:
a. Regulatory Requirements:
1) NFPA 72.
2) UL 1480.
b. General Characteristics:
1) Speakers for Voice Notification: Locate speakers for voice notification to provide intelligibility requirements of "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
2) High-Range Units: Rated 2 to 15 W.
3) Low-Range Units: Rated 1 to 2 W.
4) Mounting: Flush, semi-recessed, or surface mounted as directed by Architect.
5) Matching Transformers: Tap range matched to acoustical environment of speaker location.
6) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:
1. Performance Criteria:
a. Regulatory Requirements:
1) NFPA 72.
2) UL 1971.
b. General Characteristics:
1) Rated Light Output:
(a) 15/30/75/110 cd, selectable in field.
2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
3) Mounting: Wall mounted unless otherwise indicated.
4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
5) Flashing must be in temporal pattern, synchronized with other units.
6) Strobe Leads: Factory connected to screw terminals.
7) Mounting Faceplate: Factory finished.
8) Color: Per Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.

B. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.03 INSTALLATION OF EQUIPMENT

A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before other trades have completed cleanup must be replaced.
   2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
   3. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (460 mm) centers around full perimeter of concrete base.
   4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   6. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch (1980 mm) above finished floor.

C. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in normal path of egress within 60 inch (1520 mm) of exit doorway.
   2. Mount manual fire-alarm box on background of contrasting color.
   3. Operable part of manual fire-alarm box must be between 42 and 48 inch (1060 and 1220 mm) above floor level. Devices must be mounted at same height unless otherwise indicated.

D. Smoke- and Heat-Detector Spacing:
   1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing must not exceed 30 ft.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Air-Sampling Smoke Detectors: If using multiple pipes runs, runs must be pneumatically balanced.

H. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within dwelling or suite, they must be connected so that operation of smoke alarm causes alarm in smoke alarms to sound.

J. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

K. Audible Alarm-Indicating Devices: Install not less than 6 inch (150 mm) below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.

L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch (150 mm) below ceiling. Install devices at same height unless otherwise indicated.

3.04 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.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.05 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.06 PATHWAYS

A. All fire alarm cable shall be installed in dedicated EMT pathways unless otherwise noted.

B. Exposed EMT must be painted red enamel unless in public space.

3.07 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch (910 mm) from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated HVAC duct systems.
   4. Magnetically held-open doors.
   5. Electronically locked doors and access gates.
   6. Alarm-initiating connection to elevator recall system and components.
   7. Alarm-initiating connection to activate emergency lighting control.
   8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   9. Supervisory connections at valve supervisory switches.
   10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   11. Supervisory connections at elevator shunt-trip breaker.
   12. Data communication circuits for connection to building management system.

13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

3.08 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in location visible from FACU.

3.09 GROUNDING

A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

A. Field tests must be witnessed by Architect and authorities having jurisdiction.

B. Administrant for Tests and Inspections:
   1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.

C. Tests and Inspections:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
      b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
   2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
   4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
   5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
   6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 MAINTENANCE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
   1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
   2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
   3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.12 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 28 46 21.11

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